

Thank you for purchasing this Esco Biological Safety Cabinet. Please read this manual thoroughly to familiarize yourself with the many unique features and exciting innovations we have built into your new equipment. Esco provides many other resources at our website, www.escoglobal.com, to complement this manual and help you enjoy many years of productive and safe use of your Esco products.



User and Service Manual

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Airstream®

Class II
Biological Safety Cabinet

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APPENDIX

Warranty Terms and Conditions

Esco warrants that the product described in this manual will perform according to specifications for a period of 36 months from the date of purchase.

Esco's limited warranty covers defects in materials and workmanship. During the warranty period, Esco's liability shall be, at our option, to repair or replace any defective parts of the product, provided if proven to the satisfaction of Esco that these parts were defective at the time of being sold, and that all defective parts shall be returned, properly identified with a Return Authorization.

This limited warranty covers parts ONLY and not transportation / insurance charges.

This limited warranty does not cover:

- Freight or installation (inside delivery handling) damage. If your product was damaged in transit, you must file a claim directly with the freight carrier
- Products with missing or defaced serial numbers
- Products for which Esco has not received payment
- Problems that result from:
 - External causes such as accident, abuse, misuse, problems with electrical power, improper operating environmental conditions
 - Servicing not authorized by Esco
 - Usage that is not in accordance with product instructions
 - Failure to follow the product instructions
 - Failure to perform preventive maintenance
 - Problems caused by using accessories, parts, or components not supplied by Esco
 - Damage by fire, floods, or acts of God
 - Customer modifications to the product

Factory installed, customer specified equipment or accessories are warranted only to the extent guaranteed by the original manufacturer. The customer agrees that in relation to these products purchased through Esco, our limited warranty shall not apply and the original manufacturer's warranty shall be the sole warranty in respect of these products. The customer shall utilize that warranty for the support of such products and in any event not look to Esco for such warranty support.

Esco encourages user to register product online at www.escoglobal.com/warranty or complete the warranty registration form included with each product.

ALL EXPRESS AND IMPLIED WARRANTIES FOR THE PRODUCT, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES AND CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN TIME TO THE TERM OF THIS LIMITED WARRANTY. NO WARRANTIES, WHETHER EXPRESS OR IMPLIED, WILL APPLY AFTER THE LIMITED WARRANTY PERIOD HAS EXPIRED. ESCO DOES NOT ACCEPT LIABILITY BEYOND THE REMEDIES PROVIDED FOR IN THIS LIMITED WARRANTY OR FOR SPECIAL, INDIRECT, CONSEQUENTIAL OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, ANY LIABILITY FOR THIRD-PARTY CLAIMS AGAINST YOU FOR DAMAGES, FOR PRODUCTS NOT BEING AVAILABLE FOR USE, OR FOR LOST WORK. ESCO'S LIABILITY WILL BE NO MORE THAN THE AMOUNT YOU PAID FOR THE PRODUCT THAT IS THE SUBJECT OF A CLAIM. THIS IS THE MAXIMUM AMOUNT FOR WHICH ESCO IS RESPONSIBLE.

These Terms and Conditions shall be governed by and construed in accordance with the laws of Singapore and shall be subject to the exclusive jurisdiction of the courts of Singapore.

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 Singapore: +65 6542 0833
 Global Email Helpdesk: support@escoglobal.com

Visit <http://www.escoglobal.com/> to talk to a Live Support Representative
 Distributors are encouraged to visit the Distributor Intranet for self-help materials.

Policy updated on 30th Jan 2007 (*This limited warranty policy does not apply to products purchased before 30th Jan 2007*).

Introduction

1. Products Covered

Esco Class II Biological Safety Cabinet - Airstream					
Electrical Rating	0.6 meters 2 feet	0.9 meters 3 feet	1.2 meters 4 feet	1.5 meters 5 feet	1.8 meters 6 feet
220-240 V AC, 50Hz, 1Φ	AC2-2E1	AC2-3E1 AC2-3S1	AC2-4E1 AC2-4S1 AC2-4D1 AC2-4G1	AC2-5E1 AC2-5S1	AC2-6E1 AC2-6S1 AC2-6D1 AC2-6G1
110-120 V AC, 50Hz, 1Φ	AC2-2E2	AC2-3E2 AC2-3S2	AC2-4E2 AC2-4S2	AC2-5E2 AC2-5S2	AC2-6E2 AC2-6S2
220-240 V AC, 60Hz, 1Φ	AC2-2E3	AC2-3E3 AC2-3S3	AC2-4E3 AC2-4S3 AC2-4D3 AC2-4G3	AC2-5E3 AC2-5S3	AC2-6E3 AC2-6S3 AC2-6D3 AC2-6G3

2. Safety Warning

- Anyone working with, on or around this equipment should read this manual. Failure to read, understand and follow the instructions given in this documentation may result in damage to the unit, injury to operating personnel, and / or poor equipment performance.
- Any internal adjustment, modification or maintenance to this equipment must be undertaken by qualified service personnel.
- The use of any hazardous materials in this equipment must be monitored by an industrial hygienist, safety officer or some other suitably qualified individual.
- Before you process, you should thoroughly understand the installation procedures and take note of the environmental / electrical requirements.
- In this manual, important safety related points will be marked with the symbol. 
- If the equipment is used in a manner not specified by this manual, the protection provided by this equipment may be impaired.

3. Limitation of Liability

The disposal and / or emission of substances used in connection with this equipment may be governed by various local regulations. Familiarization and compliance with any such regulations are the sole responsibility of the users. Esco's liability is limited with respect to user compliance with such regulations.

4. European Union Directive on WEEE and RoHS

The European Union has issued two directives:

- **Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE)**

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:



Esco sells products through distributors throughout Europe. Contact your local Esco distributor for recycling/disposal.

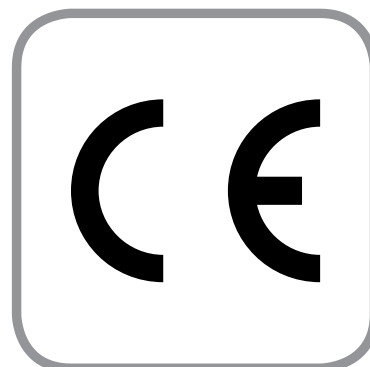
- **Directive 2002/95/EC on Restriction on the use of Hazardous Substances (RoHS)**

With respect to the directive on RoHS, please note that this hood falls under category 8 (medical devices) and category 9 (monitoring and control instruments) and is therefore exempted from requirement to comply with the provisions of this directive.

Declaration of Conformation

In accordance to EN ISO/IEC 17050-1:2004

We, Esco Micro Pte. Ltd.
of 21 Changi South Street 1
Singapore, 486777
Tel: +65 6542 0833
Fax: +65 6542 6920



declare on our sole responsibility that the product:

Category : Class II Biological Safety Cabinet
Brand : Airstream
Model : AC2-4D1, AC2-6D1
AC2-2E1, AC2-3E1, AC2-4E1, AC2-5E1, AC2-6E1
AC2-4G1, AC2-6G1
AC2-3S1, AC2-4S1, AC2-5S1, AC2-6S1

in accordance with the following directives:

2006/95/EEC : The Low Voltage Directive and its amending directives
89/336/EEC : The Electromagnetic Compatibility Directive and its amending directives

has been designed to comply with the requirement of the following Harmonized Standard:

Low Voltage : EN 61010-1:2001
EMC : EN 61326-1:2006 Class B
Design/ : EN 12469:2000 Class II Biological Safety Cabinet
Performance
Criteria

More information may be obtained from Esco's authorized distributors located within the European Union. A list of these parties and their contact information is available on request from Esco.

A handwritten signature in black ink, appearing to read 'Lin Xiang Qian', is written over a horizontal line.

Lin Xiang Qian
Vice President of Engineering Division

This Declaration of Conformity is only applicable for 230V AC 50Hz units

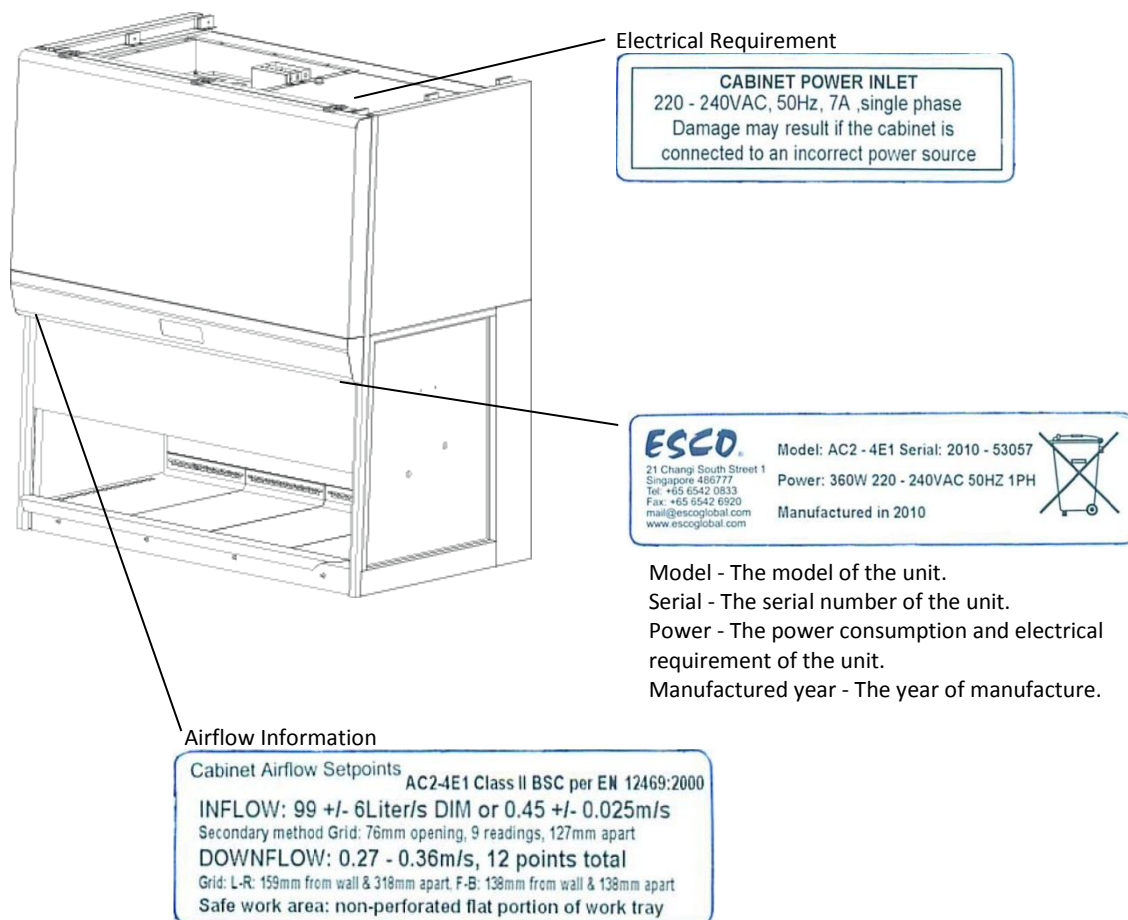
Chapter 1 - Product Information

1.1 About Airstream Biological Safety Cabinets (BSCs)

The Esco Airstream Class II Biological Safety Cabinet is a cost effective solution to providing operator, product and environmental protection within laboratories and industrial facilities. The Airstream features the use of 2 ULPA filters to deliver ISO Class 3 air cleanliness to the work zone.

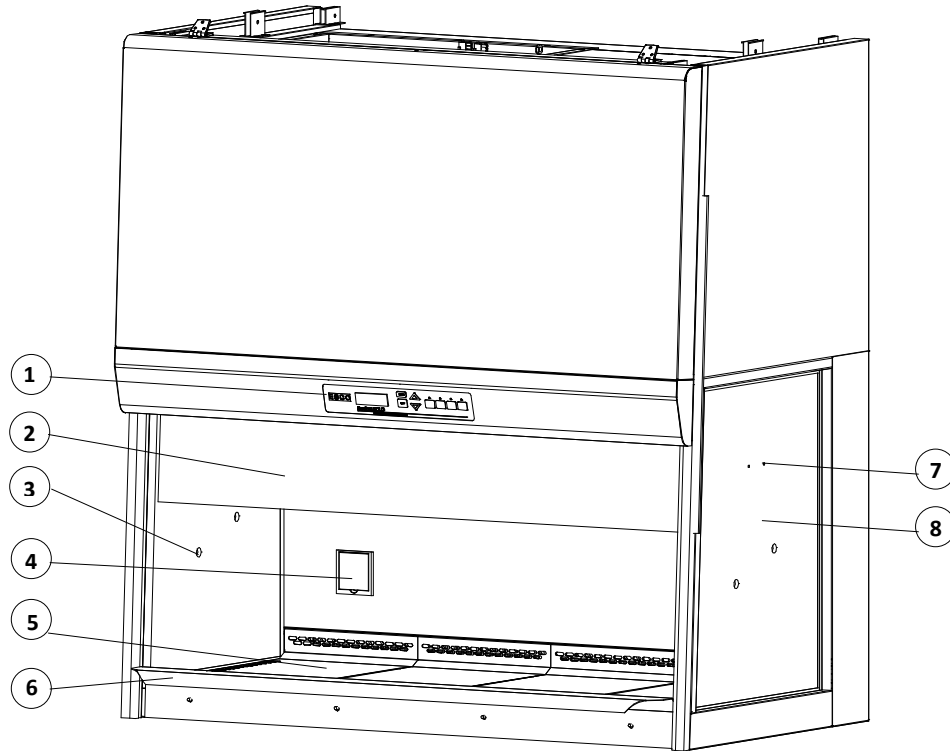
The Esco Airstream Class II Biological Safety Cabinet has been independently certified and type-tested by Health Protection Agency (HPA, formerly CAMR, the Centre for Applied Microbiological Research, Porton Down, Salisbury, UK) for compliance with the Class II requirements of the EN12469:2000 (European standard for microbiological safety cabinets). The type-testing performed included stringent evaluations of cabinet airflows, containment, and operator comfort factors.

1.2 Labels



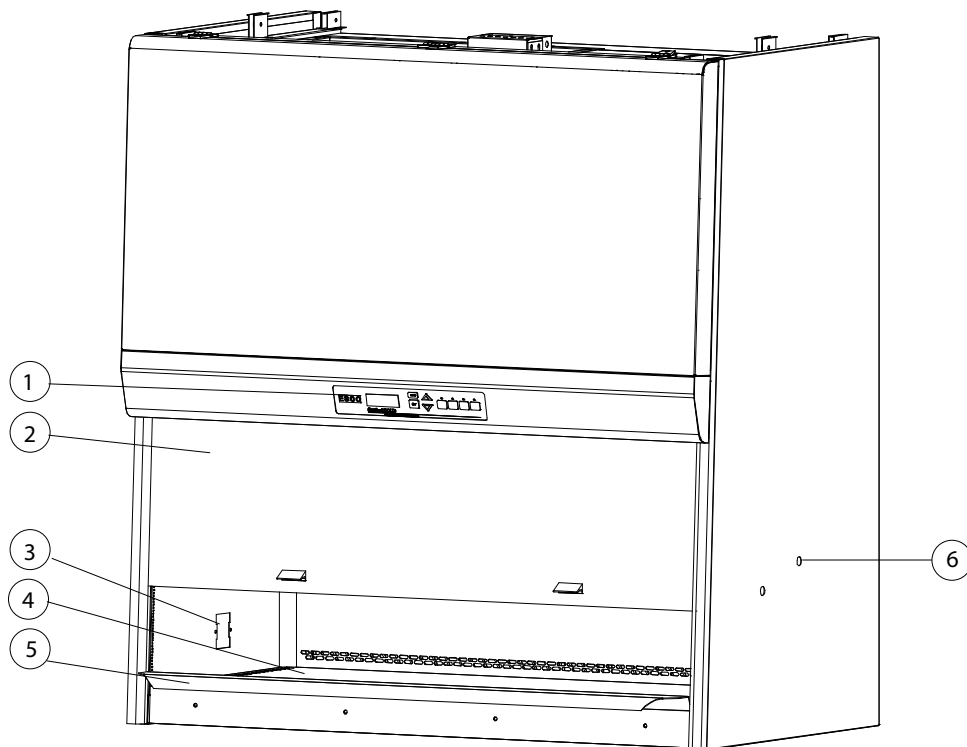
1.3 Quick View

1.3.1 AC2-_E_ & AC2-_G_ Series Quick View



- | | |
|---|--------------------------------|
| 1. Esco Sentinel Control System | 5. Interior Work Area |
| 2. Sash Window | 6. Armrest |
| 3. Service Fixture Provision (optional) | 7. IV Bar Provision (optional) |
| 4. Electrical Outlet Provision (optional) | 8. Glass Side Wall |

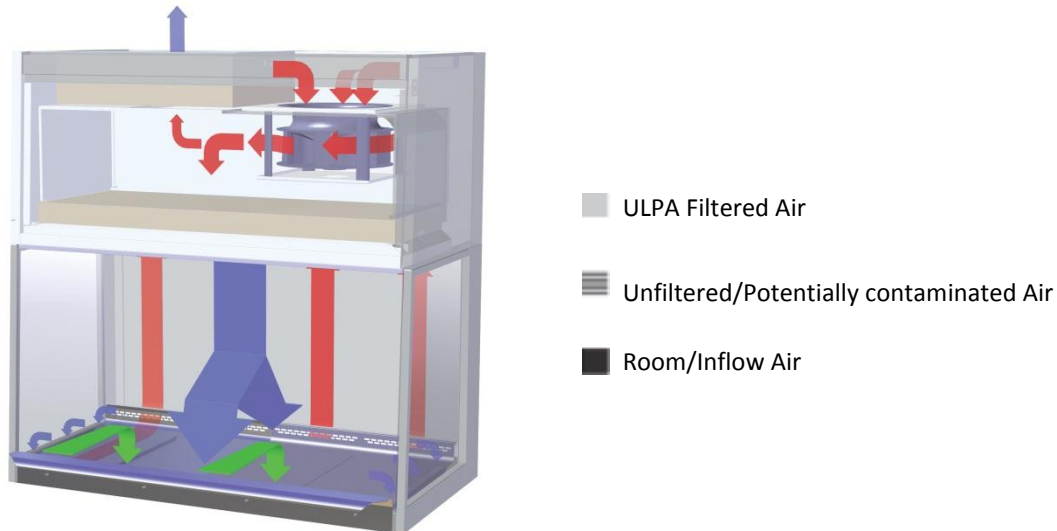
1.3.2 AC2-_S_ and AC2-_D_ Series Quick View



- | | |
|---|---|
| 1. Esco Sentinel Control System | 4. Interior Work Area |
| 2. Sash Window | 5. Armrest |
| 3. Electrical Outlet Provision (optional) | 6. Service Fixture Provision (optional) |

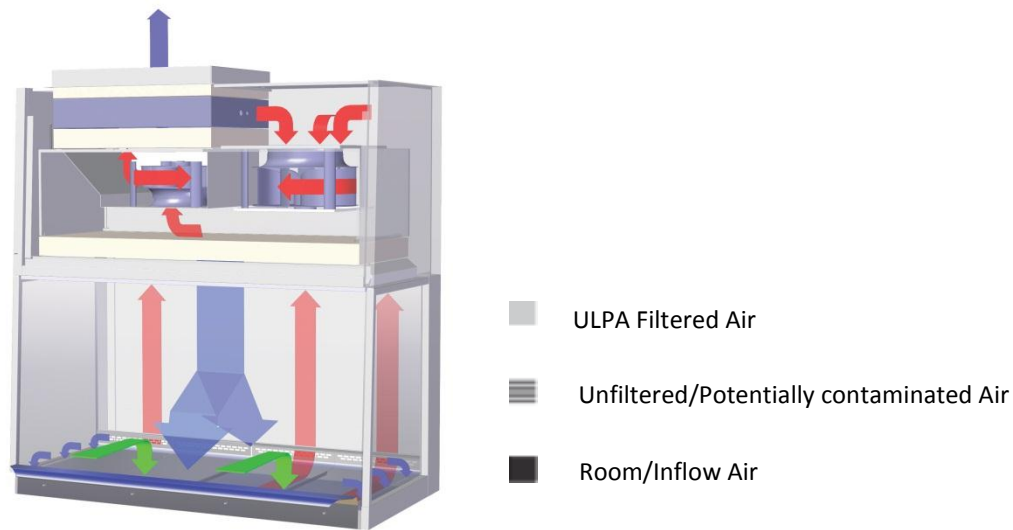
1.4 Airflow Pattern

1.4.1 AC2-_E_ and AC2-_S_ Series Airflow Pattern



- Ambient air is pulled through the perforations located towards the work zone front to prevent contamination of the work surface and work product. The inflow does not mix with the clean air within the cabinet work zone. Inflow air travels through a return path toward the common air plenum (fan plenum) at the top of the cabinet.
- The uniform, non-turbulent air stream protects against cross contamination within and throughout the work area.
- Near the work surface, the downflow air stream splits with a portion moving toward the front air grille, and the remainder moving to the rear air grille. A small portion of the ULPA filtered downflow enters the intake perforations at the side capture zones at a higher velocity (small purple arrows).
- A combination of inflow and downflow air streams forms an air barrier that prevents contaminated room air from entering the work zone, and prevents work surface emissions from escaping the work zone.
- Air returns to the common air plenum where the 32% exhaust and 68% recirculation process is continued.
- Optimized air curtain maintains personnel and product protection even in the unlikely event of inflow and downflow imbalance that would compromise protection on a conventional cabinet.

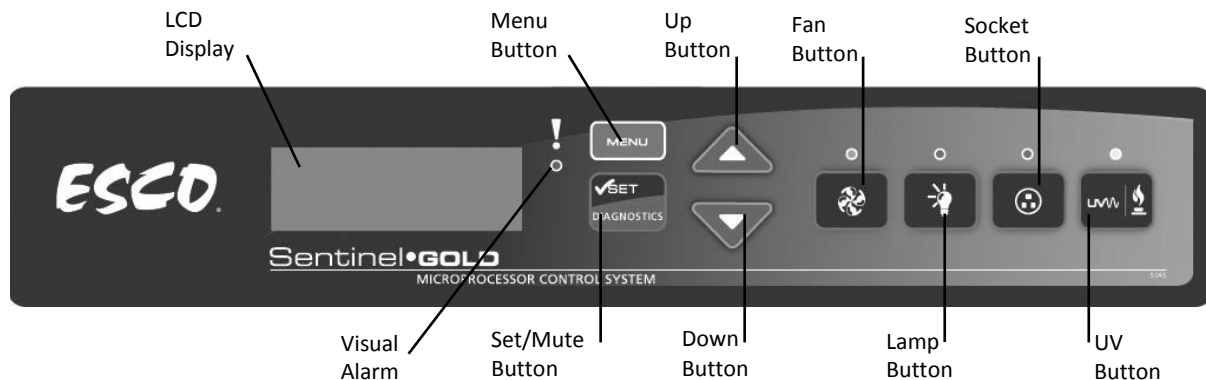
1.4.2 AC2- _D_ and AC2- _G_ Series Airflow Pattern



- Ambient air is pulled through the perforations located towards the work zone front to prevent contamination of the work surface and work product. The inflow does not mix with the clean air within the cabinet work zone. Inflow air travels through a return path toward the common air plenum (fan plenum) at the top of the cabinet.
- Dual fans and dual exhaust filters provide an added measure of protection. If the primary fan fails, the secondary fan still pushes the air across the exhaust filters to maintain inflow and containment.
- Approximately 32% of the air in the common plenum is exhausted through the ULPA filter to the room. The remaining 68% of the air is passed through the downflow ULPA filter and into the work area as a vertical laminar flow air stream bathing the work surface in clean air.
- The uniform, non-turbulent air stream protects against cross contamination within and throughout the work area.
- Near the work surface, the downflow air stream splits with a portion moving toward the front air grille, and the remainder moving to the rear air grille. A small portion of the ULPA filtered downflow enters the intake perforations at the side capture zones at a higher velocity (small purple arrows).
- A combination of inflow and downflow air streams forms an air barrier that prevents contaminated room air from entering the work zone, and prevents work surface emissions from escaping the work zone.
- Air returns to the common air plenum where the 32% exhaust and 68% recirculation process is continued.
- Optimized air curtain maintains personnel and product protection even in the unlikely event of inflow and downflow imbalance that would compromise protection on a conventional cabinet.

Chapter 2 – Sentinel Control System

2.1 Sentinel Control System



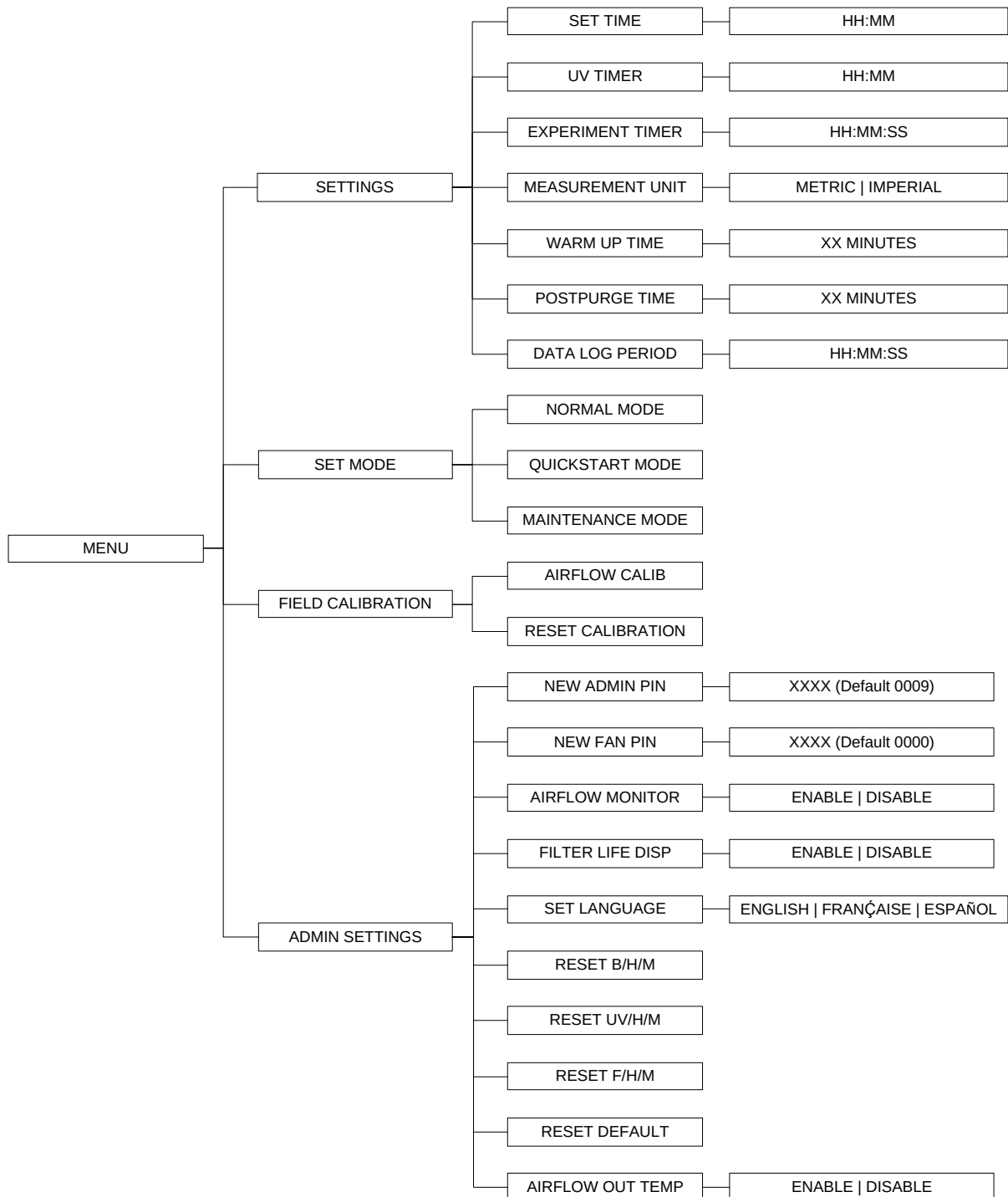
1. Fan Button
 - Turns on and turn off the fan.
2. Lamp Button
 - Turns on and turn off the fluorescent lamps.
3. Socket Button
 - Turns on and turn off the electrical socket (retrofit kit).
 - The maximum rating of all the outlets in the cabinet is 5 A. If overload, the fuse will blow.
4. UV Button
 - Turns on and turn off the UV lamp.
 - UV lamp can only be activated when the sash window is fully closed. Since the sash is capable of filtering UV rays, users are protected from the harmful UV radiation.
5. Up (▲) and Down (▼) Arrow Button
 - Move the menu options upwards and downwards.
 - Increase and decrease corresponding value inside one of the menu options.
 - Move the sash window upward and downward (for motorized sash BSC).
 - Accessing the stopwatch and experiment timer function (for non-motorized sash BSC).
6. Set or Mute Button
 - Choose the menu or sub-menu currently displayed on the LCD screen.
 - Proceed to the next step or sequence inside one of the menu options.
 - To mute the alarm sound (only in fully open state during normal mode)
7. Menu Button

When you are entering menu options, the alarm will sound to indicate that the microprocessor is not monitoring the operation of the cabinet. No further warnings will be given.

- To enter and exit from the menu options.
- To go back to the previous level of the menu options.
- To access maintenance mode from ERR.MSWITCH and AIRFAIL! error condition.

2.2 Menu Options

Please refer to the following diagram for complete reference to all menu options available.

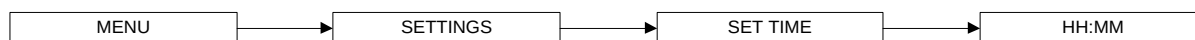


2.2.1 Settings

Users may use the settings menu function to customize the operation of the BSC to meet specific application requirements. The settings menu can be entered using both FAN PIN and ADMIN PIN.

2.2.1.1 Set Clock (Time)

Users can set the time by increasing/decreasing the hour and minute values. The correct time will be maintained even after the unit is turned off.



To Set Time:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose SET TIME. Press SET button to confirm.
6. The time is set in HH:MM format. Use UP / DOWN buttons to choose the hour (HH). Press SET button to confirm. Do the same for the minute
7. The display will show TIME SET for a few second and then return to SETTINGS.
8. Press MENU button twice to return to the main display.

2.2.1.2 UV Timer

UV timer can be used to switch off the UV lamp automatically after a fixed period. The UV timer can be set up to 18 hours. By default, the timer is set to 60 minutes, which is considered the most effective UV decontamination time. Esco does not recommend leaving the UV lamp on for more than 60 minutes as it shortens the lifespan of the UV lamp. Without the UV timer, the lamp has to be switched off manually.



To Set UV Timer:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose UV TIMER. Press SET button to confirm.
6. The time is set in HH:MM format. Use UP / DOWN buttons to choose the hour (HH). Press SET button to confirm. Do the same for the minute.
7. The display will show UV TIMER SET for a few second and then return to SETTINGS.
8. Press MENU button twice to return to the main display.

2.2.1.3 Experiment Timer

Experiment timer is a countdown timer that can be used for critical experiment. Experiment timer can be set between “00:00:00” and “17:59:59”.

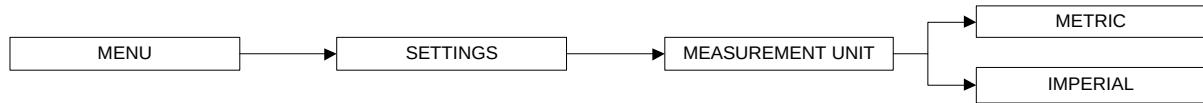


To Set Experiment Timer:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose EXPERIMENT TIMER. Press SET button to confirm.
6. The time is set in HH:MM:SS format. Use UP / DOWN buttons to choose the hour (HH). Press SET button to confirm. Do the same for the minute and second.
7. The display will show EXPERIMENT TIMER SET for a few second and then return to SETTINGS.
8. Press MENU button twice to return to the main display.

2.2.1.4 Measurement Unit

Using this option, the user can select the unit in which air velocity is measured and displayed. The user can choose between metric (m/s) and imperial (fpm).



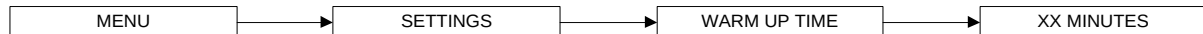
To Set Measurement Unit:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose MEASUREMENT UNIT. Press SET button to confirm.
6. Use UP / DOWN buttons to choose between METRIC and IMPERIAL. Press SET button to confirm.
7. The display will return to SETTINGS.
8. Press MENU button twice to return to the main display.

2.2.1.5 Warm Up Time

There will be a period of warm-up, before the fan is fully functioning. This is to ensure that the sensors, the blower, and the control system are stabilized, as well as purging the work zone of contaminants. The default setting is 3 minutes and the user can set it between 3 to 15 minutes.

During the warm up period, the user can use the FAN button to turn off the blower, LIGHT button to turn on and off the fluorescent lamp and MENU button. However, to be able to access the menu, the user need to input ADMIN PIN and even then, some portions of the menu (WARM UP and all FIELD CALIBRATION) is still not accessible for the user. Entering the menu during this time will pause the warm up period.



To Set Warm Up:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose WARM UP TIME. Press SET button to confirm.
6. The time is set in MM format. Use UP / DOWN buttons to set the warm-up period. Press SET button to confirm.
7. The display will show WARM UP SET for a few second and then return to SETTINGS.
8. Press MENU button twice to return to the main display.

2.2.1.6 PostPurge Time

After the user switches off the BSC blower, there will be a post-purge period, to ensure that all contaminants are purged from the work zone. The default setting is zero minute (disable) and user can set it between 0 to 15 minutes. However, it is recommended to purge the BSC for around 3 minutes after the work is complete.



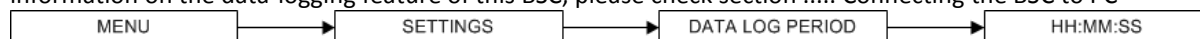
To Set Post Purge:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose POSTPURGE TIME. Press SET button to confirm.
6. The time is set in MM format. Use UP / DOWN buttons to set the post purge period. Press SET button to confirm.

7. The display will show POST PURGE SET for a few second and then return to SETTING
8. Press MENU button twice to return to the main display.

2.2.1.7 Data Log Period

Using RS232 communication port, the BSC can send data on the condition of the BSC to a PC. Data Log Period option allows the user to control the amount of time in between the BSC data sending procedure. For more information on the data-logging feature of this BSC, please check section Connecting the BSC to PC

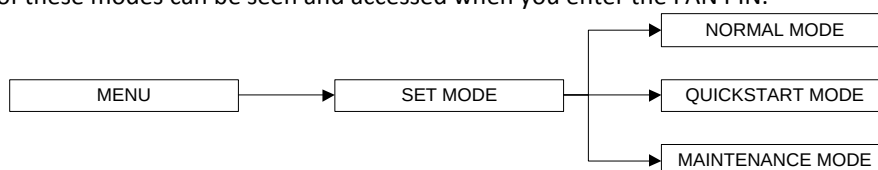


To Set Data Log Period:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose DATA LOG PERIOD. Press SET button to confirm.
6. The time is set in HH:MM:SS format. Use UP / DOWN buttons to choose the hour (HH). Press SET button to confirm. Do the same for the minute and second.
7. The display will show DATA LOG PERIOD SET for a few second and then return to SETTING
8. Press MENU button twice to return to the main display.

2.2.2 Setting Mode

AC2 BSC has three working mode; two of which, normal mode and quickstart mode, can be used in daily activity. Both of these modes can be seen and accessed when you enter the FAN PIN.



To Set the Mode:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN and ADMIN PIN, then it will ask for the appropriate PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose SET MODE. Press SET button to confirm.
5. Use UP / DOWN buttons to choose between NORMAL MODE, QUICKSTART MODE and MAINTENANCE MODE. Press SET button to confirm.
6. The display will return to SET MODE.
7. Press MENU button twice to return to the main display.

2.2.2.1 Normal Mode

The normal mode is activated by factory default. In this mode, all alarms and interlocks are enabled.

2.2.2.7 Quickstart Mode

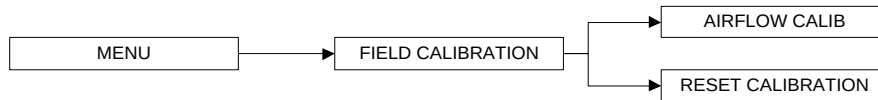
Quickstart mode allows the user to activate the blower and the light simply by opening the sash window to the operating position. In this mode, all alarms and interlocks are enabled.

2.2.2.3 Maintenance Mode

Maintenance mode should only be accessed by qualified personnel during maintenance. In this mode, all alarms are disabled and all interlocks are defeated.

2.2.3 Field Calibration

The purpose of calibration is to ensure the accuracy of the airflow display and alarm (if present). This involves measuring airflow with reference instrumentation and establishing reference between airflow sensor(s) on the BSC to the standard reference. Calibration should only be carried out by trained personnel. This section is presents a brief overview of the calibration menu function. For more information, refer to test report.



2.2.3.1 Airflow Calibration

This option allows proper calibration and operation of the airflow sensor alarm. There will be three points to be calibrated, namely inflow fail point, inflow nominal point, and downflow nominal point.

2.2.3.2 Reset Calibration

This option allows the user to reset all value calibrated in the field and return it to the values gathered in factory calibration.

2.2.4 Admin Settings

The admin menu allows you to change both FAN and ADMIN PIN. The reset blower, filter and UV hour meter functions are usually used after you change the blower, filter or UV lamp as they can easily give you the indication on when to do BSC maintenance. While the reset default function will return the options in the settings menu to their factory settings.

2.2.4.1 New ADMIN PIN (default 0009)

ADMIN PIN restricts access to some of the more delicate menu functions, namely admin and field calibration, which should only be accessed by a qualified personnel. User must enter four digits ADMIN PIN before accessing these menus.

ADMIN PIN can also be used to switch to maintenance mode from ERR.MSWITCH and AIR FAIL! error condition.



To Set New ADMIN PIN:

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose NEW ADMIN PIN. Press SET button to confirm.
6. The FAN PIN consists of 4 numerical digits (XXXX) that the user must enter one by one. Use UP / DOWN buttons to choose the first digit (X). Press SET button to confirm. Do the same for the following 3 digits
7. The display will show CONFIRM PIN? Press SET button to confirm.
8. The display will return to ADMIN SETTINGS.
9. Press MENU button twice to return to the main display.

2.2.4.2 New FAN PIN (default 0000 - DISABLED)

FAN PIN restricts access to fan control and some parts of the menu, settings and set mode. User must enter four-digit PIN before switching fan on or off. As such, it can restrict access to operating the BSC by unauthorized personnel. It will also prevent unauthorized shutdown of the BSC when continuous operation is required. Note that continuous operation is recommended for better safety. Fan PIN is also needed to disable the alarm when the sash is fully raised and cleaning needs to be performed.

It is recommended that the Fan PIN be issued only to personnel authorized to use the BSC. With FAN PIN, the user can access admin and set mode parts of the menu.

Setting the PIN to 0000 will disable this feature. The FAN PIN is disabled by default. When the FAN PIN is disabled, the BSC can be turned on and off without requiring PIN, however to access the menu, the user is still required to enter the FAN PIN (0000).



To Set New FAN PIN:

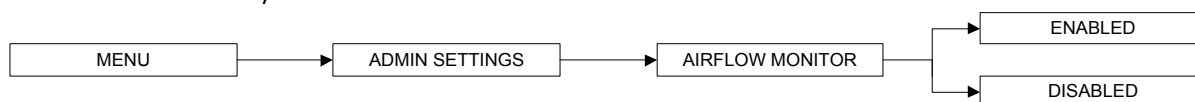
1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose NEW FAN PIN. Press SET button to confirm.
6. The FAN PIN consists of 4 numerical digits (XXXX) that the user must enter one by one. Use UP / DOWN buttons to choose the first digit (X). Press SET button to confirm. Do the same for the following 3 digits
7. The display will show CONFIRM PIN? Press SET button to confirm.
8. The display will return to ADMIN SETTINGS.
9. Press MENU button twice to return to the main display.

2.2.4.3 Airflow Monitor

Whenever the air velocity falls below the fail point, the air fail alarm will be triggered. This option is used to enable/disable alarm. The alarm is enabled by default.

When the Airflow Monitor is disabled, the warm up period is removed. But the airflow will not be displayed for the first three minutes.

If the ambient temperature is outside of 18-30°C (which is the cabinet working temperature), the Airflow Monitor is automatically disabled



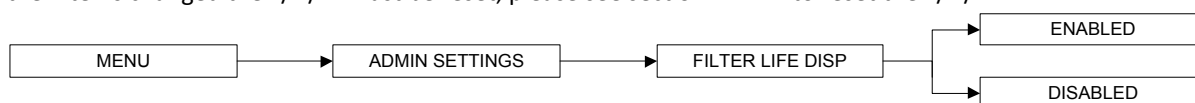
To Set A/F Monitor:

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose AIRFLOW MONITOR. Press SET button to confirm.
6. Use UP / DOWN buttons to choose between ENABLED and DISABLED. Press SET button to confirm.
7. The display will return to ADMIN SETTINGS.
8. Press MENU button twice to return to the main display.

2.2.4.4 Filter Life Display

Using this option, the user can select the whether the filter life is displayed or not.

Filter life is calculated based on the filter hour meter (F/H/M). The filter life display will count down according to the amount of hours left in the filter hour meter with respect to filter life expectancy of 10000 hours. When the filter is changed the F/H/M must be reset, please see section 2.2.4.7 to reset the F/H/M.

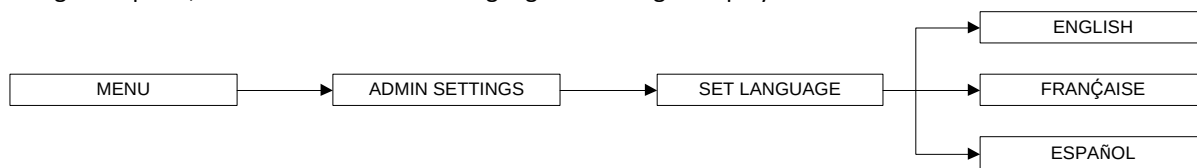


To Set Filter Life Disp:

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose FILTER LIFE DISP. Press SET button to confirm.
6. Use UP / DOWN buttons to choose between ENABLED and DISABLED. Press SET button to confirm.
7. The display will return to ADMIN SETTINGS.
8. Press MENU button twice to return to the main display.

2.2.1.5 Language

Using this option, the user can select the language of messages displayed on LCD



To Set Language:

1. Press MENU button to enter the menu display – if the BSC is secured by a FAN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the FAN PIN or ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose SET LANGUAGE. Press SET button to confirm.
6. Use UP / DOWN buttons to choose between ENGLISH, FRANÇAISE and ESPAÑOL. Press SET button to confirm.
7. The display will return to ADMIN SETTINGS.
8. Press MENU button twice to return to the main display.

2.2.4.5 Reset B/H/M

This option is used to reset the blower hour meter. The blower hour meter indicates how long the blower has been in operation. There's no maximum value in blower hour meter. The counter value can be checked while in the diagnostic mode. The value can also provide some help in setting up maintenance schedule.



To Reset B/H/M:

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose RESET B/H/M. Press SET button to confirm.
6. The display will show READ MANUAL and PRESS SET. Press SET button to confirm.
7. The display will show CONFIRM?. Press SET button to confirm.
8. The display will return to ADMIN SETTINGS.
9. Press MENU button twice to return to the main display.

2.2.4.6 Reset UV/H/M

This option is used to reset the UV lamp hour meter. The UV lamp hour meter indicates how long the UV lamp has been in operation. Maximum counter is set at 2000 hours (100%). The counter value can be checked while in the diagnostic mode. Please reset the UV lamp hour meter after each UV lamp replacement.



To Reset UV/H/M:

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose RESET UV/H/M. Press SET button to confirm.
6. The display will show READ MANUAL and PRESS SET. Press SET button to confirm.
7. The display will show CONFIRM?. Press SET button to confirm.
8. The display will return to ADMIN SETTINGS.
9. Press MENU button twice to return to the main display.

2.2.4.7 Reset F/H/M

This option is used to reset the filter hour meter. The filter hour meter indicates how long the filter has been in operation. Maximum counter is set at 10000 hours (100%). The counter value can be checked while in the diagnostic mode. Please reset the filter hour meter after each filter replacement.



To Reset F/H/M:

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose RESET F/H/M. Press SET button to confirm.
6. The display will show READ MANUAL and PRESS SET. Press SET button to confirm.
7. The display will show CONFIRM?. Press SET button to confirm.
8. The display will return to ADMIN SETTINGS.
9. Press MENU button twice to return to the main display.

2.2.4.8 Reset Default

User can reset the default setting by choosing this option. The features being reset are warm-up period (3 minutes), post-purge period (0 minute), UV timer (60 minute), measurement unit (Metric), Airflow monitor (enabled), ADMIN PIN (0009), Filter Life Display (disabled) and FAN PIN (0000).

Note that the calibration settings cannot be reset as it may cause the BSC to operate in an unsafe manner. The hour meters cannot be reset either.

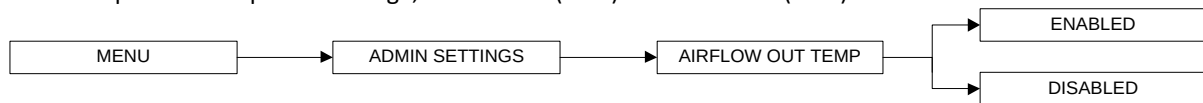


To Reset Default

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose RESET DEFAULT. Press SET button to confirm.
6. The display will show READ MANUAL and PRESS SET. Press SET button to confirm.
7. The display will show CONFIRM?. Press SET button to confirm.
8. The display will return to ADMIN SETTINGS.
9. Press MENU button twice to return to the main display.

2.2.4.9 Airflow Out Temp

Using this option, the user can select the whether or not to display the airflow when the ambient temperature is out of optimum temperature range, below 18°C (65°F) or above 30°C (86°F).



To Set Filter Life Display:

1. Press MENU button to enter the menu display – if the BSC is secured by an ADMIN PIN, then it will ask for the PIN, otherwise go to step 3.
2. Use UP / DOWN button to enter the ADMIN PIN digit by digit. Press SET button to confirm.
3. The alarm buzzer will sound.
4. Use UP / DOWN buttons to choose ADMIN SETTINGS. Press SET button to confirm.
5. Use UP / DOWN buttons to choose AIRFLOW OUT TEMP. Press SET button to confirm.
6. Use UP / DOWN buttons to choose between ENABLED and DISABLED. Press SET button to confirm.
7. The display will return to ADMIN SETTINGS.
8. Press MENU button twice to return to the main display.

2.3 Stopwatch and Experiment Timer

- The stopwatch function can be started by pressing the UP button while the sash is in the safe/ready position. Pressing UP button again while the stopwatch function will stop and resume the timer. Pressing DOWN button will leave the stopwatch function and reset the timer. The timer in the stopwatch function is counting up and shown using the HH:MM:SS format.
- The experiment timer can be started by pressing the DOWN button while the sash is in the safe/ready position. Pressing DOWN button while the experiment timer function is working will stop and resume the timer. Pressing the UP button will leave the experiment timer function and reset the timer. The timer in the experiment timer function is counting down and shown using the HH:MM:SS format. Operator can use the SETTINGS | EXPERIMENT TIMER menu (refer to section 2.2.1.3) to set the experiment timer.

2.4 Alarms and Warnings

BSC uses alarms to indicate that the condition inside the BSC is not safe for the operator, so check the LCD display to understand the cause of these alarms. The most common alarm is the SASH ALARM that indicates that the sash is neither at the normal operating height nor at fully closed position (UV mode) – this condition can easily be corrected by putting the sash at the appropriate operation position.

Another warning that should be acted upon is AIR FAIL! which indicates that there is airflow failure. The operator should check if there is any obstruction to the airflow, and correct it if possible. However, if the problem continues, the operator should stop working as the BSC's protection may have been compromised. Call service or Esco's local distributor.

Other alarms that indicate a failure or an error in the BSC system:

- AIRFLOW: NO! will be displayed if the blower is turned off while there is an airflow failure.
- SASH:ERROR POSITION will be displayed if the microprocessor (controller) detects more than one micro-switch activated at the same time, which is impossible, as the sash can only be at one position at one time. This indicates a failure in the sash detection system.
- SENSOR UNCALIBRATED will be displayed if the airflow velocity sensor is not yet calibrated.

2.5 Diagnostic Mode

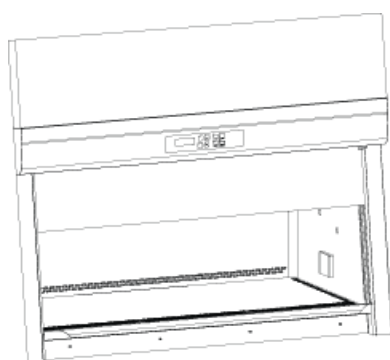
Diagnostic mode can be accessed by pressing the SET button. The diagnostic mode allows the user to know the condition of the BSC or help the service engineer during maintenance and troubleshooting.

On Screen	Explanation
MODE	Shows which mode is active: NORMAL MODE, QUICKSTART MODE or MAINTENANCE MODE
VERSION	Shows the version of the software; eg: CP104D V 1.0
TEMPERATURE	Shows the temperature inside the cabinet.
B/H/M	Blower Hour Meter – increase by the hour.
FILTER LIFE	Shows percentage of filter life (based on Filter Hour Meter) and expected filter life of 10000 hours.
AF OUT TEMP	Velocity display status when temperature out of range
UV LIFE	Shows percentage of UV lamp life (based on UV Lamp Hour Meter).
UV TIMER	Shows the UV timer value – default is 60 minutes. Maximum value is 00 minutes (infinite on).
ADC IFF	ADC for Fail Point Inflow – calculated using offset based on Inflow Nominal Point.
ADC IFN	ADC for Nominal Point Inflow – based on field calibration.
ADC IFA	ADC for Actual Inflow – showing real time sensor reading.
ADC IF0	ADC for factory calibrated Zero Point Inflow (no inflow).
ADC IF1	ADC for factory calibrated Fail Point Inflow.
ADC IF2	ADC for factory calibrated Nominal Point Inflow.
DFN	Nominal of Downflow – keyed in during factory or field calibration.
CONSTANT	Airflow sensor constant. This value is needed when ordering a new sensor.
CALIB TEMP	Temperature when the factory calibration was performed.
ADC TEMP	ADC value for TEMPERATURE.
M_SWITCH1	Shows the condition of magnetic switch 1 – fully open position.
M_SWITCH2	Shows the condition of magnetic switch 2 – safe position.
M_SWITCH3	Shows the condition of magnetic switch 3 – fully closed position.
TYPE	Cabinet type

Chapter 3 – Basic Cabinet Operation

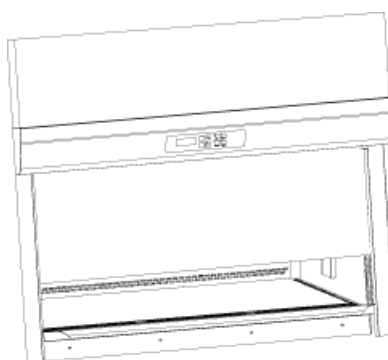
3.1 Sash Window Operation

3.1.1 Sash Window State



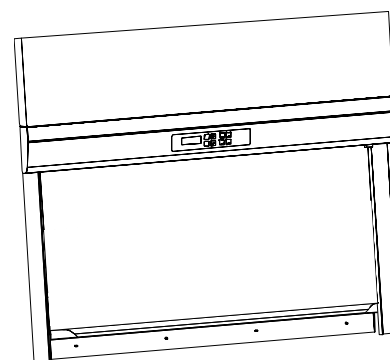
Sash is fully open

- ✓ Blower can be active
- ✓ Fluorescent lights can be used
- ✗ Unsafe working condition



Sash is in safe position

- ✓ Blower can be activated
- ✓ Fluorescent lights can be used
- ✓ Safe working condition



Sash is fully closed

- ✗ Blower can't be activated
- ✗ Fluorescent lights can't be used

3.1.2 Operating Motorized Sash Window (Only for BSC with motorized sash window)

The motorized sash uses a “push and hold” mechanism, so if you remove your finger from the button the sash will stop immediately – this is a safety feature to control the closure and prevent anything getting trapped in the aperture as the sash descends.

Lower Sash from Fully Open Position

When the sash is fully open, pressing the down button and holding it will cause the sash to move to the Safe Height setting and stop. If the fluorescent lights are on as the sash descends, they will stay on as long as the sash stops in the Safe Position. If you release the button before the sash has reached Safe Position the lights will switch off automatically.

Lower Sash from Safe Height Position

When the sash is at safe operating height pressing the down button and holding it will cause the sash to move down to the fully closed position and stop. If the fluorescent lights are on as the sash descends, they will switch off automatically as soon as the sash reaches fully closed. If you release the button before the sash has reached the fully closed position the lights will switch off automatically.

Raise Sash from Fully Closed Position

When the sash is fully closed, pressing the up button and holding it will prompt the user to input the password to turn on the fan. If the password is correct, if it was on fan will turn on and the sash will move up to the Safe Height setting and stop.

Raise Sash from Safe Height Position

When the sash is safe operation position, pressing the up button and holding it will cause the sash to move up to the fully open position and stop. If the fluorescent lights are on as the sash rises, they will stay on as long as the sash is allowed to fully open. Stopping the sash midway will cause the lights to switch off automatically.

3.1.3 Using Sash Window

- The sash window should be fully closed when the cabinet is not in use. This helps keep the work zone interior clean.
- The sash window should always be in the normal operating height at all times when the cabinet is in use. Even if the cabinet is left unattended, but the blower is on, the sash window should never be moved from the normal operating height, unless during loading or unloading of materials/apparatus into the cabinet.
- The alarm will be activated whenever the sash window is moved from the normal operating height.
- Whenever the sash window is moved to the correct height from a higher or lower position, the light will automatically be turned on as a signal to the user.
- The sash window may be opened to its maximum position for the purpose of loading/unloading of materials/apparatus into the cabinet. When the sash window is fully opened, the alarm sound may be muted by pressing MUTE button but, will be automatically sounded again after 5 minutes to remind the user that it is not safe to work in the cabinet and the light will be turned on to facilitate cleaning.

3.2 Starting and Shutting Down the BSC

3.2.1 Turning on the BSC

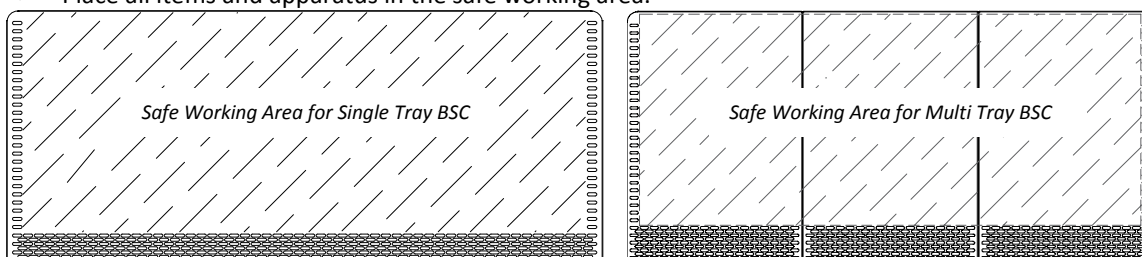
1. Raise the sash to the indicated normal operational height (READY state). The lamp will turn on when this height is reached.
Note: When Quickstart mode is selected, fan will turn on as well, without pressing the fan button.
2. Turn on the fan by pressing the FAN button. Input the Fan PIN if asked (if PIN ≠ 0000). This will start the warm up procedure (default: 3 minutes). All buttons are disabled during warm up period.
3. The BSC is ready for work.

3.2.2 Turning off the BSC

1. Turn off the fan by pressing the FAN button. Input the Fan PIN if asked (if PIN ≠ 0000). This will start the post purge procedure (default: 0 minute). All buttons are disabled during post purge period.
2. Lower the sash to the fully closed position (the display will show UV MODE). The sash can be lowered immediately after turning off the fan as it will not interrupt the post purge procedure.
Note: When Quickstart mode is selected, fan will turn off without pressing the fan button.
3. Turn on the UV lamp (when present) to decontaminate the work area by pressing the UV button. Leave the UV lamp on to make sure the decontamination is done effectively. The UV lamp can only be turned on after the post purge procedure is finished.

3.3 Working in the BSC

- Surface-decontaminate the work area (work surface, back and side wall, UV lamp, electrical outlet, service fixture and the inner surface of the sash window) before and after using the BSC.
- Allow the BSC to purge any contaminant by allowing the blower to operate at least 3 minutes before and after using the BSC.
- Surface-decontaminate any item (including your arms) or apparatus with appropriate disinfectant before entering or exiting the work area.
- Place the waste container (containment bag, pipette discard pans, etc.) inside the BSC work area.
- Place all items and apparatus in the safe working area.



- Minimize room activity (personnel movements, closing and opening of doors, etc.) since these external airflow disturbances may adversely affect the BSC's internal airflow, thereby possibly impairing the containment capabilities of the BSC.
- Ensure that the sash is at normal operating height (READY state) before starting any experiment.
- Ensure the front and back air grilles are not obstructed by your arms or any other objects.
- Work as far inside the BSC as possible - at least 150 mm (6 inches) behind the front air intake grille.
- While working in the BSC, move your hands slowly and in a controlled manner. Rapid movements may disrupt the air barrier, allowing contaminants to escape or enter the BSC.
- The use of Bunsen burner inside the work zone is not recommended. However if the use of Bunsen burner is unavoidable, place the burner in the right side of the work zone.
- Place aerosol-generating instruments as far inside the BSC as possible and at least 150 mm (6 inches) from clean items/materials.
- Place air turbulence generating equipment such as centrifuges, blenders or sonicators towards the back of the BSC. Stop other work while any of this equipment is in operation.
- As far as possible, it is recommended that the BSC be operated continuously in order to achieve optimal containment and cleanliness. Airflow studies have shown that once the fan has been switched off, air from the BSC may escape due to the thermal currents from inside the BSC.

3.4 Working Ergonomics

On most occasions, you would most likely be operating the BSC in sitting rather than standing posture. There are some obvious advantages of the sitting posture:

- The physiological energy cost and fatigue involved in sitting are relatively less
- Sitting posture provides the body with a stable support

However, sitting position has some drawbacks too:

- The working area available is fairly limited
- There is a potential risk of being constrained in the same posture for a long time
- Sitting posture is one of the most stressful postures for one's back

Therefore you should pay careful attention to the following guidelines in order to achieve comfortable and healthy working conditions:

- Always ensure that your legs have enough legroom.
- Keep your lower back comfortably supported by your chair. Adjust the chair or use a pillow behind your back whenever necessary.
- You should place your feet flat on the floor or on a footrest. Don't dangle your feet and compress your thighs.
- You should keep varying your sitting position throughout the day at regular intervals so that you are never in the same posture for too long.
- Observe the following precautions with respect to your eyes:
 - Give your eyes frequent breaks. Periodically look away from the work area and focus at a distant point.
 - Keep your glasses clean.
- Arrange the items/apparatus frequently used in your work in such a way that you can minimize the physical strain involved in handling them.
- Exercise regularly

The BSC's noise emission has been tested and found to be in compliance with EN 12469, ISO 4871 and NSF/ANSI 49 which is important to ensure health and comfort for the operator.

Ergonomics accessories available with Esco include:

- Armrest padding
- Lab chair
- Footrest

Please contact your local distributor or Esco for more information.

3.5 UV Lamps

The UV light is a very effective germicide and virucide. Even at the minimum acceptable irradiance in a BSC – $40 \mu\text{W}/\text{cm}^2$ (US Department of Health and Human Services et. al., 2000), it would only take 12.5 minutes to reach $30,000 \mu\text{W}/\text{cm}^2$ ($1 \text{ W} = 1 \text{ J}/\text{sec}$), which has been listed as germicidal for spore forming organism.

Unlike many other type of decontamination agent, UV light doesn't leave any residue. The decontamination action stops upon de-energizing of the lamp.

However, due to the short wavelength, the UV light does not penetrate well. Thus UV light can only be used to effectively disinfect the work area of an empty BSC. For any container stored inside the BSC's work area, the UV radiation will only disinfect the outer surface of the material, leaving the inner surface and the content inside the material untouched.

- UV light decontamination method may be used before and after working with vegetative organisms and viruses. However, it should not be the sole decontamination agent; the use of chemical decontamination agent is still encouraged.
- Minimize the material inside the BSC's work area during the process of UV light decontamination. A direct interaction with UV light can degenerate plastic- or rubber-based material and can cause other hazard.
- Make sure that the BSC sash is in the fully closed position and the interlock is working properly before activating the UV lamp. Avoid direct contact with skin and eyes as UV light is classified as a probable human carcinogen.
- The UV lamp should be activated for around 60 minutes to work effectively. Use the UV timer feature to easily control the period of decontamination (UV timer is disabled by default). Leaving the UV lamp on for over 60 minutes or even overnight is not recommended because it shortens the lifespan of the lamp. The UV lamps used in Esco BSC have a lifespan of 2,000 hours.
- The UV lamp should be cleaned of any dust and dirt weekly and changed annually to ensure its effectiveness.
- The use of UV lamp in BSC has been explicitly discouraged in all major international standards and recommendations.

3.6 Decontamination and Disinfecting Agents

- For stainless steel surfaces, all common disinfecting agents except chlorine-based ones are suitable.
- For powder coated surfaces, all common disinfecting agents are suitable. However, the BSC has been specifically evaluated for use with the following:
 - 1N hydrochloric acid
 - 1N sodium hydroxide
 - 1% quaternary ammonium compound
 - 5% formaldehyde
 - 5,000 ppm hypochlorite
 - 2% iodophor
 - 5% phenol
 - 70% ethyl alcohol
- Depending on the contaminant involved at the time of operating the BSC, there are various other types of disinfecting agents that may be used. The following table outlines the effectiveness of various disinfecting agents against the different types of contaminants.

Decontaminant	Glutaraldehyde	Peroxide/ Paracetic acid/ Acetic acid	Chlorine Dioxide	Chlorine	Iodophor	Alcohol	Phenolic	Quaternary Ammonium Compounds
Classification	Sterilant	Sterilant	Sterilant	High Level	Inter- mediate	Inter- mediate	Inter- mediate	Low Level
<i>Parameters for use:</i>								
Concentration	2%	1%	0.01-0.1%	0.01-5%	0.5-2.5%	70-85%	0.2-3%	0.1-2%
Contact time (min.)	10-600	10-720	10-600	10-30	10-30	10-30	10-30	10-30
Stability > 1 week ⁽¹⁾	+		+		+	+	+	+
<i>Agents:</i>								
Bacterial Endospores	+	+	+	+/-				
Naked Viruses	+	+	+	+	+/-	+/-	+/-	
Mycobacterium	+	+	+	+	+	+	+	
Vegetative Bacteria	+	+	+	+	+	+	+	+
Enveloped Viruses	+	+	+	+	+	+	+	+
<i>Characteristics:</i>								
Inactivated by Organics		+		+	+	+	+/-	+
Residual	+	+	+	+/-	+		+	
Corrosive		+		+	+		+	
Flammable						+		
Skin Irritant	+	+	+	+	+		+	
Eye Irritant	+	+	+	+	+	+	+	
Respiratory Irritant	+	+	+	+	+	+	+/-	
Toxic	+	+	+	+	+	+	+	+
<i>Use in BSCs:</i>								
Routine Surface Decon				+/-	+	+		+
Biohazardous Spill		+/-	+	+/-	+		+	+/-

(1) protected from light and air

+ = effective, +/- = results may vary, blank = not effective

Decontamination

Decontamination may frequently be carried out by means of formaldehyde fumigation or using other decontamination agents, such as chlorine dioxide or hydrogen peroxide. Decontamination process should only be carried out by trained personnel.

In any of the following eventualities, the user should ensure that the BSC has been properly decontaminated, keeping in mind the nature of the pathogens used:

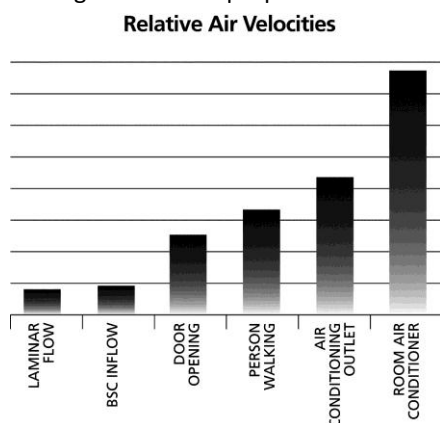
- At the time of moving/relocating the BSC
- At the time of changing the type of work being carried out in the BSC
- Before accessing contaminated areas for servicing, for example - filter replacement

Chapter 4 – Installation

4.1 General Requirement

4.1.1 Location Requirements

Placing the BSC in a proper location is important. Bad location may affect the performance of the cabinet.



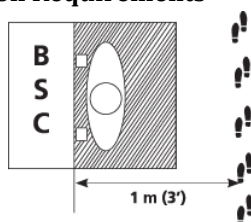
As seen in the chart, your cabinet's internal airflow velocity is relatively low, when compared to the airflow disturbances potentially caused by the opening of a door, a person walking by or a direct exposure to an air-conditioning outlet. These external airflow disturbances can affect the proper laminar flow of the BSC and impaired the protection offered by the cabinet.

When installing the BSC, it should be located as far away as possible from sources of airflow disturbance and in an orientation which optimally shields the cabinet's airflow from all external airflow disturbances.

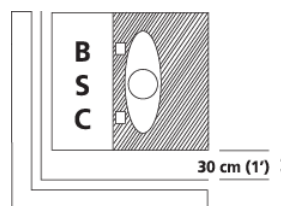
The following requirements should be taken into account:

- Poor siting of a cabinet can adversely affect performance. A specialist engineer should be consulted on correct positioning of the cabinet prior to installation.
- Cabinets should never be sited in line with a doorway, an open-able window, or adjacent to a thoroughfare. Care should be taken to ensure that possible disturbances to airflow such as room air diffusers, fans, extractors, vents, etc. are taken into account and any risk of disturbance noted and mitigated before installation.
- Room air supply diffusers should not be within 1.5 meter (5') of the front aperture. If there are large numbers of cabinets in a laboratory this recommendation may be difficult to comply with, but where diffusers have to be placed in close proximity to a safety cabinet, their discharge velocities and the force air handling rates will need to be low.
- The position of a safety cabinet should satisfy the spatial requirements (e.g. vision, lighting and convenience of access) of the operator and people working nearby. If the cabinet is installed on a bench top, the leading edge should slightly overhang or be flush with the edge of the bench top.
- There should not be an open space between the leading edge of the cabinet and the front of the bench as this may create turbulence in front of the aperture. It also provides an obstacle which could adversely affect airflow across the cabinet face.

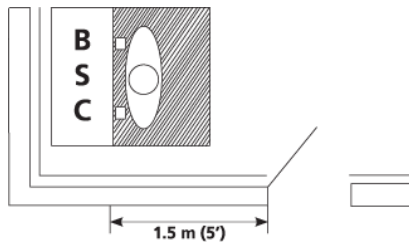
4.1.1.1 Position Requirements



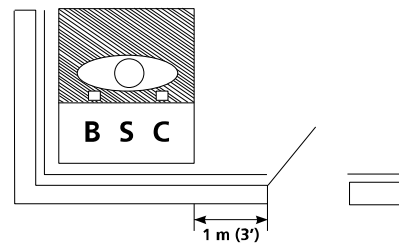
Allow at least 1.0 m (3') between the cabinet and pedestrian traffic routes, thoroughfares or walkways



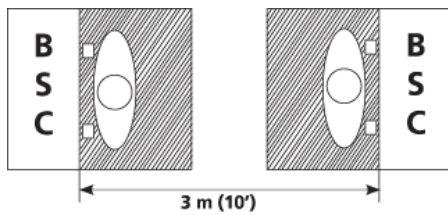
Allow at least 30 cm (1') clearance on both sides of the cabinet



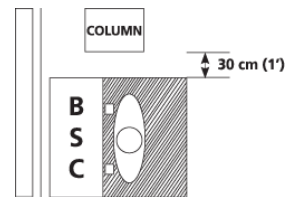
The distance between the cabinet aperture and any doorway is at least 1.5 m (5').



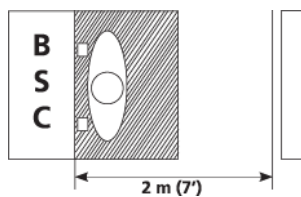
The distance between the side panel and any doorway is at least 1.0 m (3').



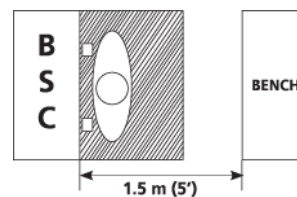
Allow at least 3m (10') between the aperture to the aperture of an opposing cabinet, fume cupboard, etc.



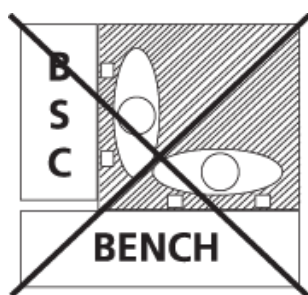
Any large obstruction projecting beyond the plane of the front aperture should not be within 30 cm (1') of the sides of the cabinet.



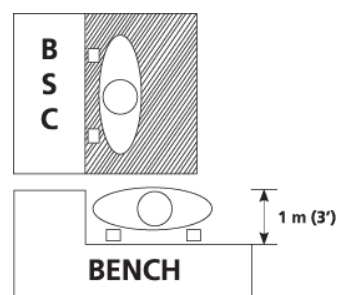
You should not position the cabinet in a location where there is an obstruction that affect airflow within 2 m (7') of the front aperture



The distance between cabinet aperture and the front of a bench opposite should be at least 1.5 m (5').



Avoid positioning a bench at right angles to the cabinet. Any person working at the bench is likely to disturb airflow close to the cabinet.



A projecting bench will help minimize traffic in front of the cabinet as long as the front of the bench is situated at least 1 m (3') from the side of the cabinet.

4.1.1.2 Relocating the Cabinet

Normally BSCs are rarely moved once they are in their ideal positions, but if the need arise to relocate or even repackaging the unit, then here is some considerations:

- Before moving the BSC, remember to decontaminate the cabinet
- Before moving the BSC, remember to secure all moving parts, ex: sash.
- BSC is heavy, be careful with the weight distribution. Usually it will take 6 or more people to move it.

For repackaging:

- Bolt the BSC to the pallet.
- Strap the BSC body down to the pallet.
- Repackage as necessary. If possible, use original packaging.
- When moving the BSC, use material handling equipment and lift the pallet.

4.1.2 Environmental Requirements

- Indoor use only
- Altitude of up to 2000 meter (6600')
- Relative humidity between 20% – 90%
- Temperature between 18°C – 30°C (65°F – 86°F)
- Pollution Degree 2.0

Pollution degree describes the amount of conductive pollutants present in an operating environment. In pollution degree 2.0, it is assumed that only non-conductive pollutants such as dust are present, except that occasional conductivity is caused by condensation.

4.1.3 Support Requirements

- The support/cabinetry should be leveled
- The support/cabinetry must be able to withstand the weight of the cabinet and any apparatus within
- The support/cabinetry must be ergonomics

- *Esco recommends Esco support stand with leveling feet for BSC*
- *Without Esco's support stand, Esco cannot guarantee the cabinet's resistance against tipping and hence the user would be solely responsible for ensuring that the cabinet is securely fastened to third party support/cabinetry.*
- *The use of non-leveling feet Esco support stand will nullify the third party certification (NSF or TÜV) that the cabinet may have, because only Esco leveling feet support stand was used during certification. The maximum NSF approved leg levelers adjustment is 50 mm (2").*

4.1.4 Exhaust Requirements

The exhaust filter area is especially susceptible to disruptive air currents or air drafts. A clearance of at least 30 cm (1') is recommended between the highest point of the cabinet and the ceiling. If the distance is less than 30 cm (1'), the airflow alarm system may need re-calibration. In fact, for proper exhaust filter leak scanning purposes, a minimum clearance of 50 cm (1'8") is recommended.

4.1.5 Electrical Requirements

- Ensure that the outlet is rated accordingly to the model requirement. The cabinet will not work properly or may even be damaged if it is powered by an incorrect source.
- The cabinet's maximum voltage fluctuation is $\pm 2\%$ of nominal voltage, otherwise install power stabilizer.
- Surge protection and UPS are strongly recommended for better protection.
- The power cable is located on the right hand side of the BSC and the cord is 2.5 m long. When preparing the installation site, try to ensure the outlet is located to the right of the cabinet for ease of access. The cabinet should be connected to an unobstructed dedicated power outlet(s).

4.1.6 Service Line Requirements

- All service lines should be installed by a suitably qualified and certified engineer, in accordance with all applicable local, state and government regulations.
- Service line attachments should be equipped with an emergency shut off valve that can be accessed quickly and with ease, should the need arises.
- Check whether there is a need to install pressure regulators to reduce the line pressure.
- Your BSC can accommodate service fixtures on the left or right hand side of the cabinet. Make allowance for the positioning of service lines when planning the installation site to ensure ease of access to emergency shut off valves.

4.2 Installation

4.2.1 Connecting the Electrical Supply

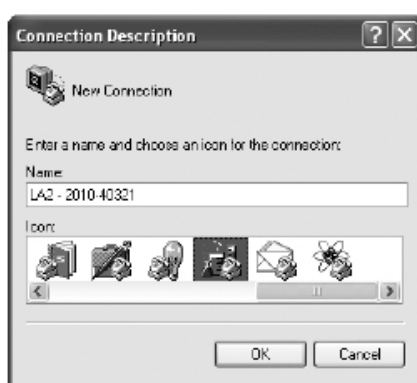
- First of all, refer to the serial label on the BSC for the proper electrical rating.
- Review the electrical wiring diagrams in Appendix section prior to installation. All wiring should be done in accordance with the National Electrical Code.
- Connect the supplied power cord to the input on the top of the BSC. Make sure the cable connector is seated firmly in the socket.

4.2.2 Connecting to a PC (using RS232)

1. Connect the RS232 female connector of the BSC to the RS232 male connector of the PC using DB9 RS232 serial cable.
2. Use these port settings for your RS232 connection:
 - Baud Rate : 2400
 - Data Bits : 8
 - Stop Bits : 1
 - Parity : None
 - Flow Control : None

If you are using Windows XP's HyperTerminal, follow these steps:

1. Click **Start**, and select **All Programs | Accessories | Communication | HyperTerminal**



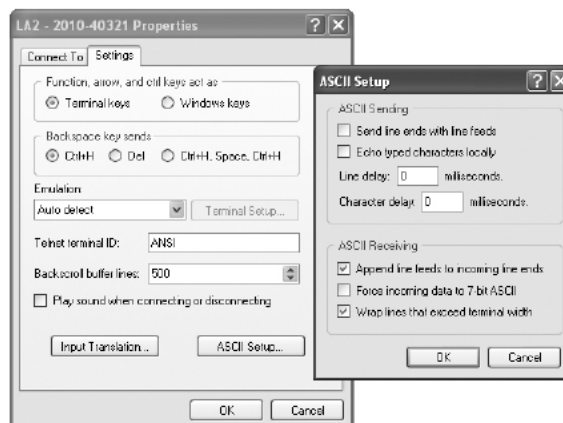
2. In the **Name** box and the **Icon** box, enter an appropriate name and icon.



3. Choose the port in the **Connect Using** drop down box, e.g.: COM1



4. Enter the connection's setting.



5. Enter **File | Properties | Setting | ASCII Setup** and tick **Append line feeds to incoming ends**

6. Click **OK** button twice to return to the HyperTerminal window. The connection is configured successfully
7. The information shown in the HyperTerminal window are current time, inflow velocity, downflow velocity, temperature, sash window position, blower hour meter, and blower condition (or warm up condition).

4.2.3 Safety and Warning Labels on the Cabinet

Anyone using the BSC should familiarize themselves with the various labels displayed in and on the cabinet. It is very important that users are familiar with the meanings of the labels before attempting to use the unit.

4.2.4 Preliminary Cleaning

Wipe the interior and exterior of the BSC with water or a mild household detergent.

4.3 Performance Validation/Certification

After the installation but before starting to use it, BSC performance must be validated and certified to factory standards. It is recommended that this validation and certification be performed only by a qualified technician who is familiar with the methods and procedures for certifying biological safety cabinets.

The test methods and equipment needed for carrying out the tests are specified on the test report.

4.3.1 Disclaimer

The performance and safety of all Esco BSC are rigorously evaluated at our factory. Regular field certification is important to ensure factory standards are maintained.

4.3.2 References for Qualified Certifiers

North America

- NSF (<http://www.nsf.org/Certified/Biosafety-Certifier/>)
- Esco (www.us.escoglobal.com)
- IAFCa-member certifying company (www.iafca.com/listview)

UK, China, India, Middle East/North Africa, Malaysia, Singapore

- Esco offers field certification services directly. Contact local Esco office.

Other Countries

- Contact Esco or local distributor

Chapter 5 – Service and Maintenance

5.1 Scheduled Maintenance

Proper and timely maintenance is crucial for trouble free functioning of any device and your Esco BSC is no exception to this rule. We strongly recommend that you follow the maintenance schedule suggested hereunder in order to obtain optimal performance from your Esco BSC.

No.	Description of Task to Perform	Maintenance to be carried out every					
		Day	Week	Month	Quarter	1 Year	2 Years
1	Surface decontaminate the work zone	√					
2	BSC power-up alarm verification	√					
3	Thoroughly surface decontaminate the drain pan		√				
4	Check the paper catch for retained materials		√				
5	Clean the exterior surfaces of the BSC			√			
6	Clean the sash window			√			
7	Check all service fixtures (where present) for proper operation			√			
8	Inspect the BSC for any physical abnormalities or malfunction				√		
9	Clean up stainless steel surfaces with MEK				√		
10	Re-certification					√	
11	Change UV Lamp (where present)					√	
12	Change the fluorescent lamps						√

Cleaning the BSC

- Clean the work surface and walls with appropriate disinfectant agent and soap water afterward
- Clean the sash window using an appropriate disinfectant agent and glass cleaner afterward
- Use a damp cloth to clean the exterior surface of the BSC, particularly on the front and top in order to remove dust that accumulated there
- Use clean water to finish the cleaning and wash away any residue of disinfectant agent, soap water and glass cleaner
- For removing stubborn stains or spots on the stainless steel surface, make use of MEK (Methyl-Ethyl-Ketone). In such cases, make sure that you wash the steel surface immediately afterwards with clean water and some liquid detergent. Use a polyurethane cloth or sponge for washing. Regularly cleaning the stainless steel surface can help you retain the attractive factory finish.

Test the audible and visual alarm

The simplest method by far would be to move the sash until the glass window is no longer in the sash ready or UV mode position.

Check the cabinet's functionality

- Check the BSC's mechanical functionality; ex: sash window – lubricate if necessary
- Check the BSC's electrical functionality; ex: fluorescent lamp – replace if necessary
- Check the BSC for any defect, repair immediately

Re-certification

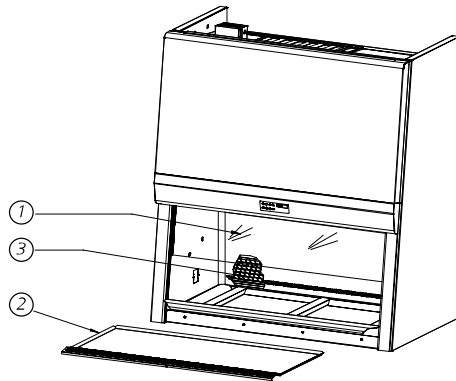
All BSC must be re-certified annually by a certified engineer. See test report for recertification procedure.

Accessing the paper catch

The purpose of accessing the paper catch is to remove any retained materials that might cause obstructions. Care must be taken as the area is contaminated.

Before opening the paper catch:

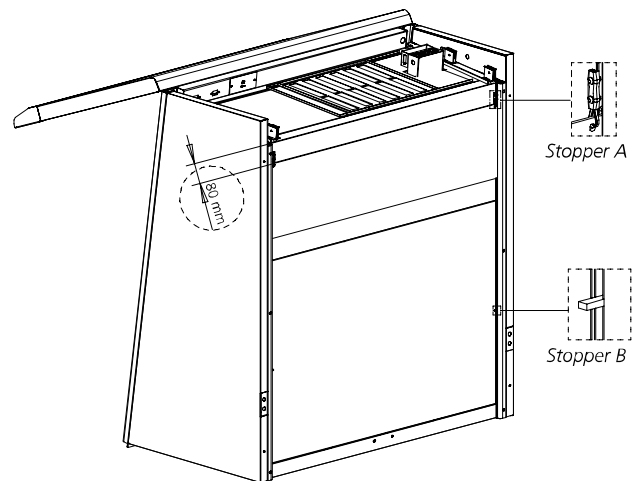
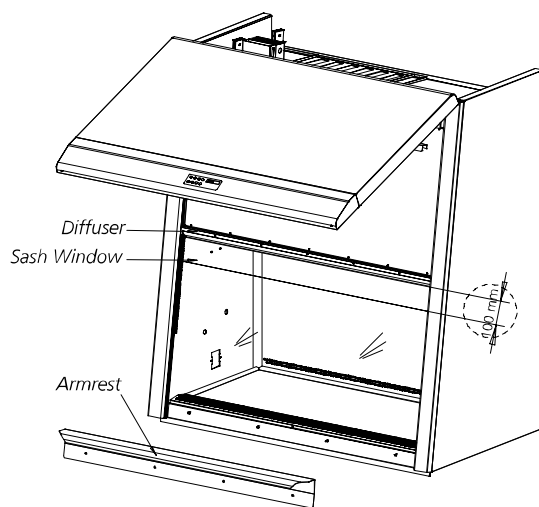
- Use appropriate personal protective equipment (PPE).
- Wipe down the interior of the BSC including the top and bottom surfaces of the work tray(s) while airflow is operating.
- If the interior cannot be wiped down, the BSC should be decontaminated



Accessing the paper catch

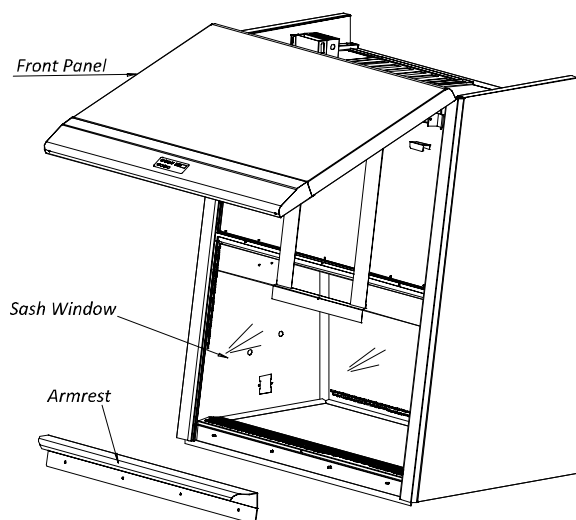
1. Turn the blower off. Then raise the sash to fully open position for easy access.
2. Remove the tray(s) to access the paper catch.
3. The figure beside, points to the location of the paper catch. Locate and remove any material trapped. Be careful of any sharp objects that might be present. You might want to use a mirror to help you see better.

Sash cleaning procedure for non-motorized sash BSC



1. Remove armrest
2. Lower the sash by continuously until the sash is in the lowest position and create a 10 cm opening between the sash and the diffuser
3. Open the front panel.
4. Slide your hand through the opening and clean the inner side of the sash using cloth and IPA 70%
5. After cleaning, push continuously until the sash is in the sash ready position
6. Close the front panel.
7. Reattach armrest

Sash cleaning procedure for motorized sash BSC



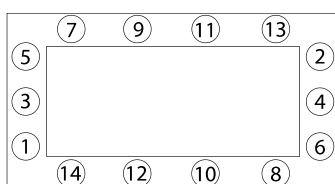
1. Remove armrest
2. Press MENU button, select SET MODE then choose MAINTENANCE MODE - this mode allows you to lower the sash further than usual
3. Lower the sash by pressing the DOWN button continuously until the sash is in the lowest position and create a 10 cm opening between the sash and the diffuser
4. Open the front panel.
5. Slide your hand through the opening and clean the inner side of the sash using cloth and IPA 70%
6. After cleaning, push the UP button continuously until the sash is in the sash ready position
7. Close the front panel.
8. Reattach armrest
9. Set the cabinet back to NORMAL MODE

5.2 Parts Replacement

The use of non-Esco parts and / or parts not supplied directly by Esco or our authorized distributors, including but not limited to maintenance parts, spare parts, replacement parts, system components and / or system accessories, shall void all expressed or implied warranties.

5.2.1 Filter Replacement Procedure

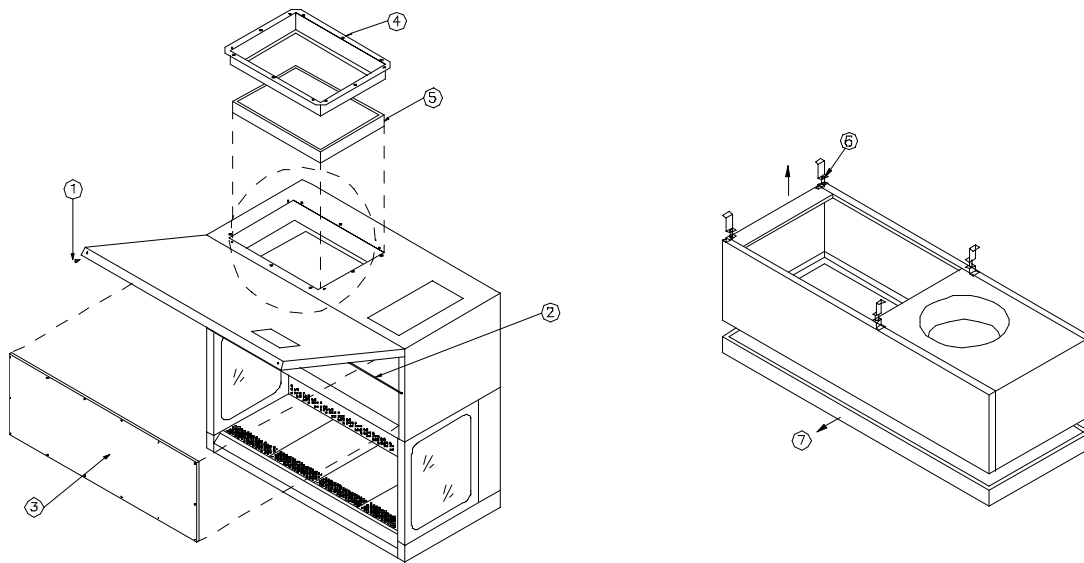
- The filters should not be replaced until the entire cabinet has been decontaminated.
- Two persons may be required to facilitate filter changing on 5' and 6' BSC.
- The two ULPA filters under normal usage and barring an accident (a puncture) do not need replacement until the inflow and/or downflow velocity cannot be maintained at the specific rate as mentioned in the test report even though the fan has been set to maximum speed.
- The cabinet must undergo re-certification after changing filter.



Two steps of tightening are necessary with the first round torque strength of one-third of the final torque required. Over tightening may cause damage to filter and cause leak.

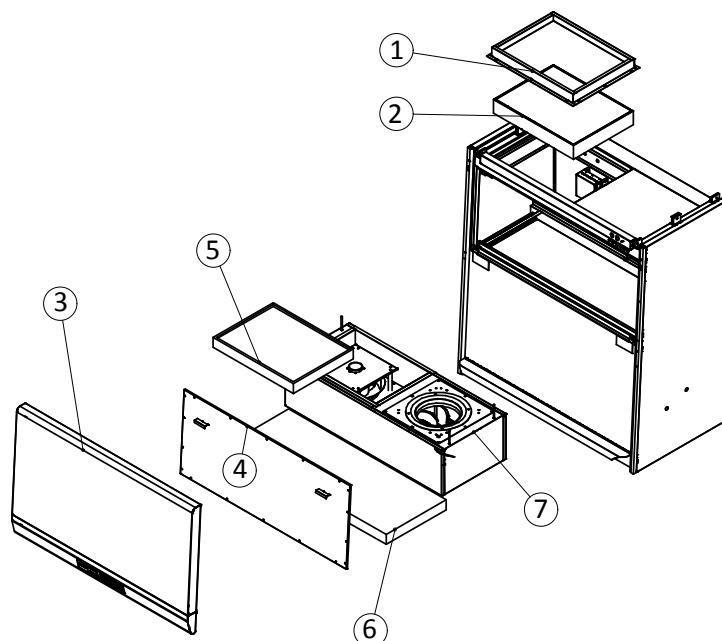
1. Before the filters are removed from the BSC, their contaminated faces should be taped off using plastic film or cardboard or some other suitable material. This will minimize the risk of personnel in the event the decontamination was not thorough.
2. Used filters should be disposed following local regulations. They may have to be incinerated as medical waste. They should be double bagged and appropriately labeled following removal from BSC.
3. Proper personnel protective attire should be worn when removing used filters (a disposable gown, gloves, facemask, hair and shoe covers are appropriate). These should be disposed after the procedure. Proper hand washing after the procedure is also necessary.
4. Before the new filters are installed, all surfaces should be thoroughly cleaned of silicon and / or adherent gasket material. The new filter should be carefully handled and examined prior to fitting. It is important that the filters and the gaskets be checked for leaks prior to use.

5.2.1.1 Filter Replacement for AC2-_E_ and AC2-_S_ Series



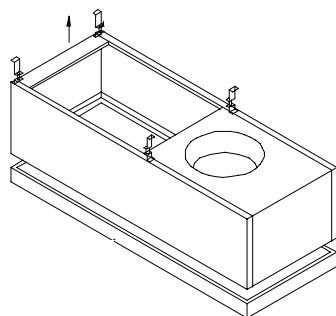
1. Remove screws from the bottom 2 sides of front panel
2. Lift up the front panel and hook up the 2 support bar housing and lift up to the maximum
3. Remove the access cover
4. Remove the exhaust filter mounting frame from the top
5. Remove the exhaust filter
6. Using the #13 spanner, turn the nut until the blower housing is lifted up to the maximum
7. Remove the filter from the front.
8. To install new filter, reverse the above procedure and note the following
 - A. When securing blower housing onto new filter, please ensure gasket compression is equal on both downflow and exhaust filter.
 - B. When securing the exhaust filter mounting frame, please do not over-tighten the nuts, use the lowest torque if using a power tool.

5.2.1.2 Exhaust Filter Replacement for AC2-_D_ and AC2-_G_ Series



1. Remove screws from bottom 2 sides of front panel (3)
2. Lift up the front panel (3) and hook up the 2 support bar housing and lift up to the maximum
3. Remove the access cover (4)
4. Remove the secondary exhaust filter mounting frame (1) from the top
5. Remove the secondary exhaust filter (2)
6. Remove the primary exhaust filter (5) from the front
7. To install the new filter, reverse the above procedures

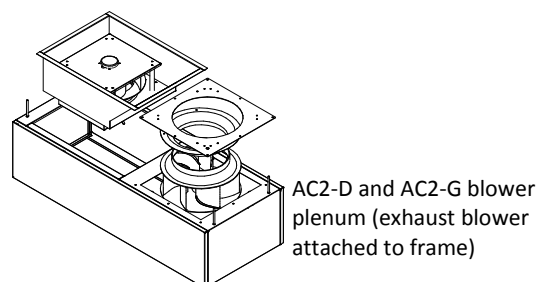
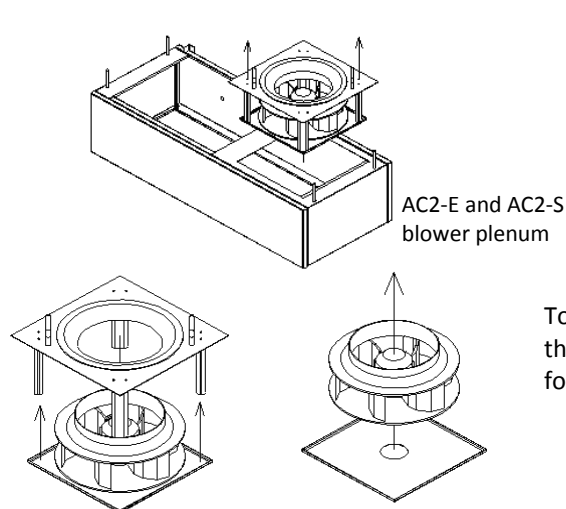
5.2.1.3 Downflow Filter Replacement for AC2-_D_ and AC2-_G_ Series



Follow step 1 – 6 on the AC2-_D_ and AC2-_G_ series exhaust filter replacement. Continue with the following steps

7. Using the spanner, turn the nut until the blower plenum (7) is lifted up to the maximum.
8. Remove the downflow filter (6) from the front.
9. To install the new filter, reverse the above procedures.

5.2.2 Blower Replacement Procedure



To replace the blower, follow the filter replacement steps until the blower plenum can be removed from the cabinet, then follow these steps:

1. Take out the blower housing
2. Unscrew the bottom plate to separate the top and the bottom section
3. Unscrew the impeller from the bottom plate

The number of blower(s) may vary between each cabinet size and series.

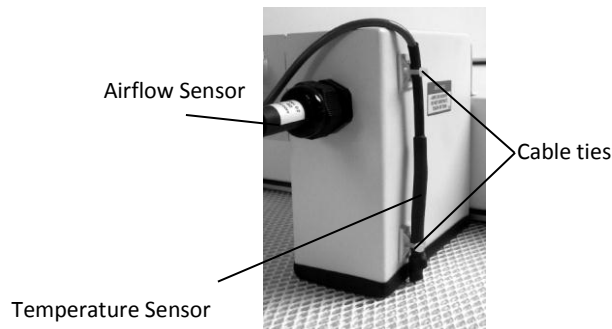
5.2.3 Fluorescent Lamp(s) Replacement Procedure

1. Disconnect the electrical connections.
2. Unfasten the two screws from the bottom of the blue panel and then lift up the blue panel.
Caution: The front panel is equipped with a gas spring which will open the front panel automatically.
3. The fluorescent lamp(s) is located behind the blue panel. Disconnect the old one(s) and replace with the new one(s).

5.2.4 UV Lamp Replacement Procedure

1. Disconnect the electrical connections.
2. Take out the old UV lamp by rotating it 90° counter clockwise and pull downward.
3. Install the new UV lamp by pushing it upward and rotating it 90° clockwise to secure the lamp in its socket.

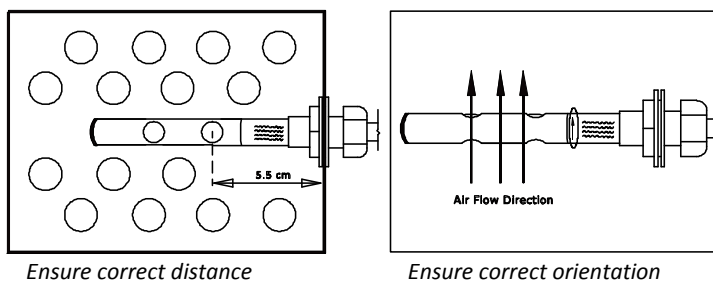
5.2.5 Airflow Sensor Replacement Procedure



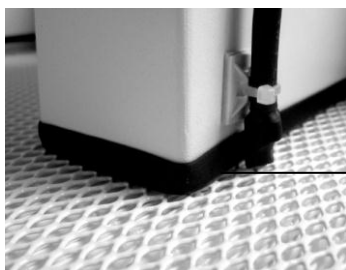
In AC2-_E_ and AC2-_S_ series, the airflow sensor is located on top of the cabinet. The sensor can easily be accessed in these cabinets.

However, in AC2-_D_ and AC2-_G_ series, the sensor is located between the primary and secondary exhaust filter. To access the sensor in these cabinets, you will need to remove the secondary exhaust filter and its frame. Do not forget to decontaminate the BSC before removing the filters.

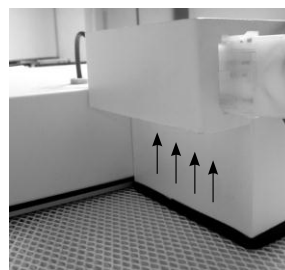
1. Start by disconnecting the airflow sensor cable connector.
2. Cut the cable ties to remove the temperature sensor.
3. Unfasten the nut connecting the airflow sensor to the sensor housing
4. Pull out the old airflow sensor from the sensor housing.
5. Push in the new sensor. Make sure that the arrow sticker on the sensor tube is pointing “up” as shown in the figure below, so that the axes of the sensor holes are parallel to the airflow direction. Also make sure that the distance between the outer sensor hole and wall of the sensor housing is 5.5 cm, as shown in the next figure:



6. Fasten the nut and reconnect the airflow sensor cable connector. Mount back the cable onto the sensor housing. Make sure that there is no gap between the housing and the filter as shown below



No gap between the casing and filter



When installing the airflow sensor, please watch the airflow direction

5.3 Maintenance/Service Log

It is good practice (and in some cases regulatory requirement) to maintain a log of all maintenance work carried out on your cabinet.

Chapter 6 – Recertification & Calibration

BSC generally require re-certification, when:

- The cabinet is re-located
- Cabinet's performance is suspected
- After filter or blower replacement
- At least once a year

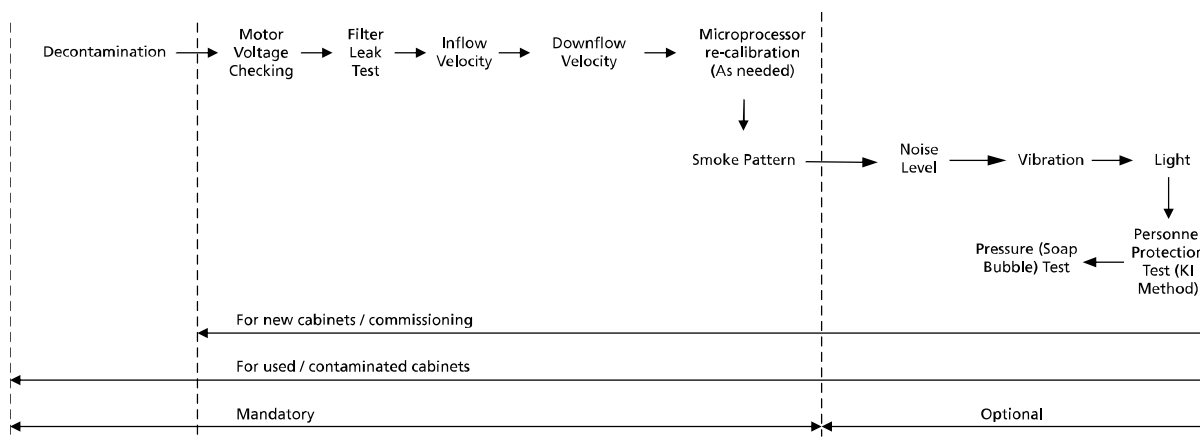
During recertification:

- Cabinet airflow velocities and flow patterns are verified against the manufacturer's specifications and relevant international standards
- Filters are scan-tested to ensure they do not leak
- Operator comfort tests may be performed
- If airflow velocities are found to be off set point, adjustments are made as part of the certification process before final values are recorded.

Airflow alarm calibration, when:

- The cause of the airflow alarm cannot be determined
- Re-certification indicates the displayed airflow deviates by >0.02 m/s (4 fpm) from actual measured velocities.

6.1 Certification Flowchart



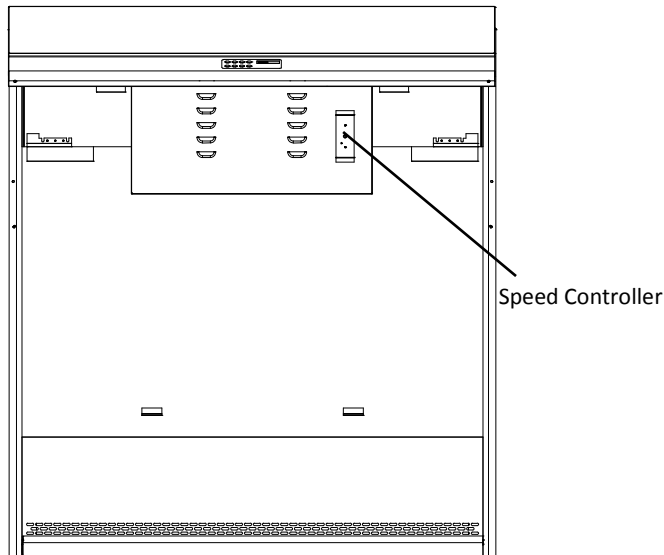
6.2 Certification and Calibration

Certification and calibration procedure can be found in the test report.

6.3 Airflow Adjustment

6.3.1 Speed Controller Adjustment

The speed controller is located in the electronics panel which is accessed by raising the front engineering access panel at the top of the front of the cabinet and then opening the drop-down cover by removing the two screws on the front left and right sides of the cover.



Plug the multimeter probes to the Motor Voltage Sampling Port. Use the multimeter to take the voltage air velocity reading.

Adjust the airflow by adjusting the speed controller. Use the provided screwdriver to adjust the controller.

6.3.2 Initial Voltage Adjustment (only for AC2- _D_ and AC2- _G_ series)

These AC2 BSCs are equipped with an exhaust fan below of the exhaust filter. This fan needs to be adjusted so that the correct balance between downflow velocity and inflow velocity is achieved.

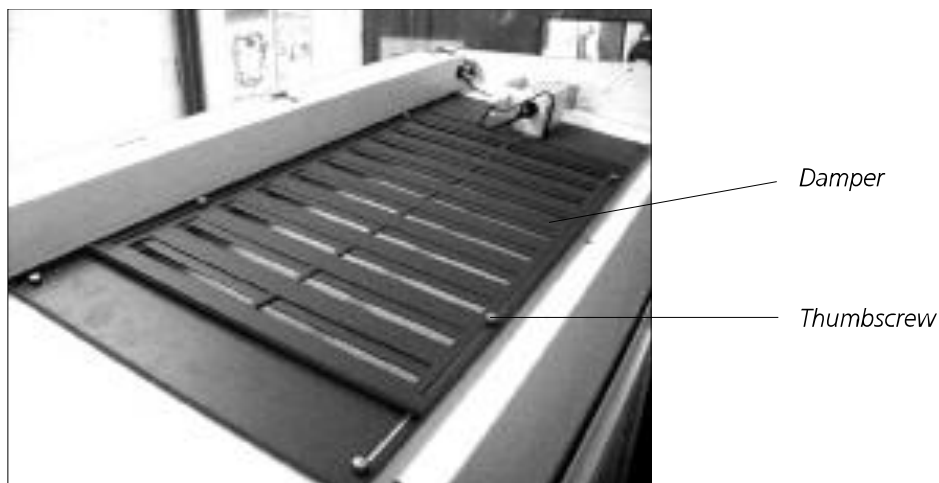
No.	Main fan	Exhaust fan	Inflow	Downflow	
1	+	+	++	+	
2	+	=	+	+	
3	+	-	++	++	
4	=	+	-	-	
5	=	=	=	=	
6	=	-	+	+	
7	-	+	--	--	
8	-	=	-	-	
9	-	-	--	-	

+ : Faster/increase in value
 ++ : Increase greatly in value
 = : Constant
 - : Slower/decrease in value
 -- : Decrease greatly in value

The BSC downflow and exhaust fan speed control need to be adjusted to get nominal downflow velocity of 0.30 m/s.

6.3.3 Damper Adjustment

The damper is used to balance the downflow velocity and exhaust velocity. The damper needs to be adjusted when the downflow velocity does not meet the accepted criteria (3, 4, 5' unit: 0.35 m/s and 6' unit: 0.33 m/s). Open the damper opening if the downflow velocity is too high; close the damper opening if the downflow velocity is too low.



Loosen the thumbscrew(s) to slide the damper left or right to increase or reduce the downflow velocity.

Chapter 7 - Decontamination

BSC decontamination should be performed in any of the following eventualities:

- Before replacing the exhaust/downflow filters or blower.
- Before accessing the contaminated negative or positive plenum of the BSC.
- In case of an accidental spillage that might have contaminated any of the inaccessible surfaces.
- Before performance validation and re-certification, especially if the BSC has been used with BSL 3 or 4 agents.
- Before BSC relocation.

Personal protective equipment such as gloves, gown, and respirator with filter suitable for the decontamination gas/vapor must also be used by the certifier performing the decontamination. Esco can provide the formalin vaporizer and decontamination bag needed for the decontamination procedure.

7.1 Decontamination Agents

7.1.1 Formalin/Paraformaldehyde Decontamination

Typically the decontamination is performed using formalin gas by either vaporizing 37% formalin solution or by de-polymerization of solid paraformaldehyde.

Despite its widespread usage for decontamination, formalin presents the following health risks:

- External contact can cause irritation to skin, eyes, and mucous membranes.
- Inhalation in small concentrations can cause coughing, nausea, and diarrhea.
- Inhalation in large concentrations can cause convulsions, coma, and death.
- Long term exposure can cause cancer.

Although the Permissible Exposure Level (PEL) for formalin is 0.75 ppm, many scientists believe that there is no safe level of carcinogen exposure to humans. Therefore, typically the room must be evacuated when the decontamination process is performed, which leads to lab down time.

The use of formalin decontamination also has other disadvantages:

- The process is time-consuming.
- The certifier needs to pulse the BSC fan to circulate the formalin vapor. This can dislodge the tape holding the plastic sheet covering the exhaust filter.
- Due to excessive residue extensive cleaning must be done after decontamination and before use.

The formalin decontamination process can require an extended period of time as outlined below:

According to OSHA [Occupational Safety and Health Administration (USA)], formaldehyde Short Term Exposure Level (STEL) is 2 ppm for 15 minutes exposure, 4 times a day, minimum of 60 minutes in between exposures. Any additional local safety regulations should also be observed. Personnel should be given adequate training.

The following links provide general guidelines on formaldehyde safety:

- Regulations (Standards - 29 CFR) Formaldehyde - 1910.1048, Occupational Safety and Health Standards, OSHA (Occupational Safety and Health Administration), U.S. Department of Labor:
<http://www.osha.gov>
- OSHA Formaldehyde Fact sheet (PDF format)
http://www.osha.gov/OshDoc/data_General_Facts/formaldehydefactsheet.pdf

No.	Process	Time
1	Set-up & sealing the BSC to make it air tight	1 hour
2	Formalin vaporization	½ hour
3	Formalin contact time to obtain target log of 4-6 kill	8 – 10 hours
4	Ammonia vaporization to neutralize formalin	½ hour
5	Ammonia contact time to neutralize formalin	2 hours
6	Exhausting the ammonia residue	1 hour
7	Tear-down & cleaning the (substantial) residue	1 hour
TOTAL without ammonia neutralization		10½ – 12½ hours
TOTAL with ammonia neutralization		14 – 17 hours

Ammonia is used to neutralize formaldehyde. OSHA prescribes the ammonia STEL is 35 ppm for 15 minutes exposure, 4 times a day, minimum of 60 minutes in between exposure.

Due to the adverse health effect of formalin gas, its use has been banned in Germany, Austria, and Switzerland. Other European countries are expected to follow suit. Two primary candidates to replace formalin decontamination are chlorine dioxide gas and hydrogen peroxide vapor.

7.1.2 Chlorine Dioxide Decontamination

Chlorine dioxide decontamination is performed by injecting chlorine gas (Cl_2) into a cylinder filled with solid sodium chlorite (NaClO_2), which generates the greenish-yellow chloride dioxide gas (ClO_2). Chlorine dioxide decontamination is much faster than formalin. Being a true gas, it spreads quickly, without the need of pulsing the BSC's blower. It can rapidly kill the micro-organisms with high efficacy with just 1 hour contact time. There is minimal residue to clean after the decontamination making the entire process much faster than formalin decontamination. The time required for the entire process of chlorine dioxide decontamination is as follows:

No.	Process	Time
1	Set-up & sealing the BSC to make it air tight	1 hour
2	Chlorine dioxide gassing	½ hour
3	Chlorine dioxide contact time	1 hour
4	Chlorine dioxide "scrubbing"	½ hour
5	Tear-down & cleaning the (minimal) residue	½ hour
TOTAL		3½ hours

Chlorine dioxide has the PEL of 0.1 ppm, compared to 0.75 ppm for formalin. In both processes airtight BSC sealing is required to protect personnel from the gas exposure.

7.1.3 Hydrogen Peroxide Decontamination

Hydrogen peroxide (H_2O_2) decontamination is performed by flash vaporization of an aqueous peroxide mixture, creating a vapor that is distributed throughout the inside the BSC.

STERIS and BIOQUELL are two major vendors of hydrogen peroxide generators. There are significant differences in operating principles.

- The STERIS principle is to avoid condensation on surfaces to minimize corrosion and optimize vapor distribution. The relative humidity inside the BSC must be lowered to 30% so that the remaining 70% relative humidity can be occupied by the hydrogen peroxide vapor. STERIS product for BSC is VHP M100 Biodecontamination System.
- The BIOQUELL principle is to seek micro-condensation to achieve the kill. The generator releases tiny high-speed droplets inside the BSC. BIOQUELL product for BSC is Clarus L.

Hydrogen peroxide vapor is non-carcinogenic, but highly effective against micro-organisms. Hydrogen peroxide (H_2O_2) vapor breaks down under catalytic action to become air and water, making it environmentally friendly and it leaves no residues. The decontamination process is as fast as chlorine dioxide if the BSC is ducted.

However, if the BSC is not ducted, the hydrogen peroxide must be aerated, which is time-consuming.

The time needed for the entire process is outlined below:

No.	Process	Time
1	Set-up & sealing the BSC to make it semi-airtight	½ hour
2	Conditioning and decontamination cycle	1 ½ hour
3	Ducting out H ₂ O ₂	½ hour
4	Tear-down	½ hour
TOTAL		3 hours

For hydrogen peroxide decontamination, the BSC need to be equipped with two ports:

1. One port located in front opening or side wall, penetrating the work zone area
2. One port located on top of the exhaust filter.

The generator used defines the port function as described below:

	Steris	Bioquell
Hydrogen peroxide source	Injected into the BSC	Generated inside the BSC
Bottom front / side port	Hydrogen peroxide introduction	Hydrogen peroxide re-introduction
Top port	Hydrogen peroxide extraction	Hydrogen peroxide extraction

7.1.4 Comparison Table

No.	Aspect	Formalin Vapor	Chlorine Dioxide	Hydrogen Peroxide
1	Is it carcinogenic?	Yes	No	No
2	Is it a genotoxin?	Yes	No	No
3	Permissible Exposure Level (PEL)	0.75 ppm	0.1 ppm	1 ppm
4	Immediately Damaging to Life & Health (IDLH)	2 ppm	5 ppm	75 ppm
5	Sealing of BSC	Must be airtight	Must be airtight	Small gaps are OK
6	Lab evacuated during the process?	Yes, due to leakage danger	Yes, due to leakage danger	No, people can still work in lab
7	Is room humidity control required?	Yes, above 60%	Yes, between 60 to 80 %	No
8	Residue	Substantial, needs extensive cleaning	Minimal, in the form of NaCl	No residue. Needs no cleaning at all.
9	Decontamination time per BSC	11-17 hours	3-4 hours	3-11 hours
10	Equipment cost	US\$ 100 - \$ 2,000 (reusable)	US\$ 1,500 + Cl gas canister (reusable for several times)	US\$ 18,000 - \$ 52,000 (reusable)

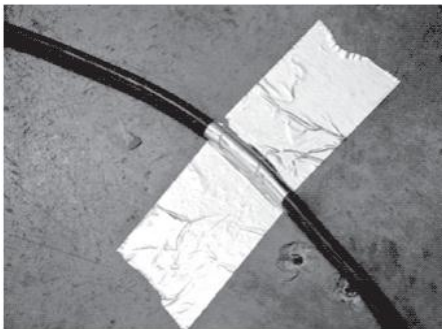
7.2 Recommended Decontamination Sealing Method



1. Put the decontamination bag to enclose the entire BSC and support stand
2. Use the 50 mm wide aluminum tape to seal the gap between the decontamination bag and the floor. To compensate for areas where the decontamination bag must turn, use multi section tape. Ensure that the two layers of tape overlap



3. Overlap the tape at the joints



5. To seal the cable, first make an Ω -shape aluminum tape around the cable, and make a 5 cm flat portion going to both directions. Then, paste the aluminum tape to the floor.



at the end points to prevent leakage.



4. These 2 cables (for BSC and for vaporizer) should be combined so that only 1 cable should come out from the decontamination bag, to minimize chance of formalin leakage



6. Put the bottom part of the decontamination bag on top of the aluminum tape, and then seal it with another layer of aluminum tape. Use multiple layer of aluminum tape (*at least 2 layers*) on both directions to ensure leak tightness.

7. The BSC is ready for formalin decontamination.

Chapter 8 – Troubleshooting

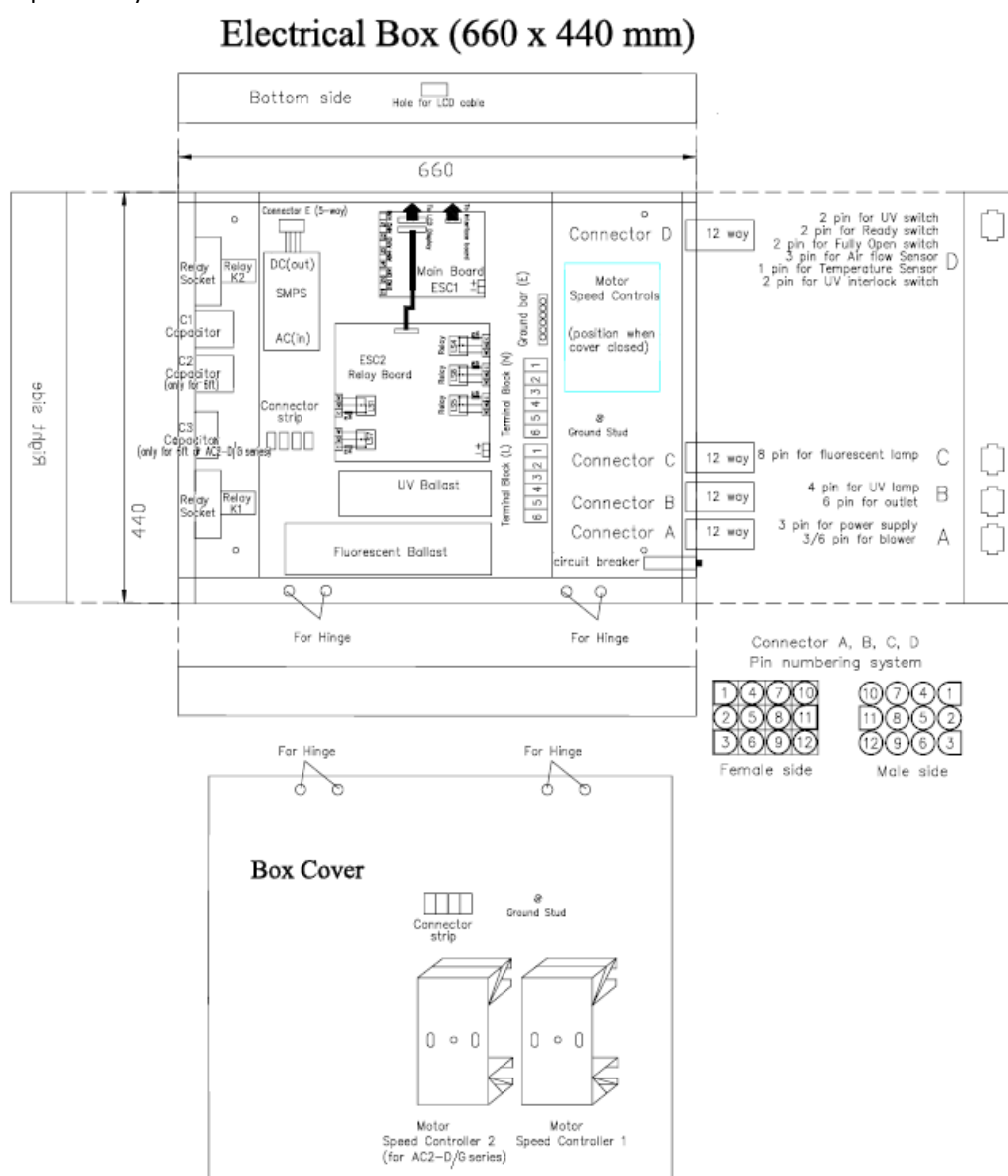
This guide addresses the most common service issues. For more trouble shooting or service information contact your local ESCO Distributor.

Hardware:

- DVM (Digital Voltage Meter).
- **Note:** An analog meter can be used for troubleshooting, but cannot be used for motor voltage measurement.
- Phillips screwdriver
- Insulated jumper cables

The Electrical Panel and Component Layout:

Open the front panel, the electrical panel is the red covered box located on the back of the panel. The component layout is as followed:



Problem 1: Cabinet does not start (LCD, button, fan light, and socket are inoperative)

Cause	Corrective Action
Power Failure	- Check wall outlet for power - If the outlet has a switch make sure it is ON
Power cord is not connected properly or faulty	- Ensure the power cord is connected correctly to the wall outlet NOTE: Some cabinets have 2 cords. - Disconnect the cord at the cabinet and measure the AC voltage between the live and the neutral terminal of the cord - If the voltage is not within $\pm 2\%$ of the wall socket voltage, replace cord; otherwise proceed to next step
Circuit breaker has tripped	- Check the circuit breaker inside the electrical panel. NOTE: If circuit breaker has tripped, do not reset the breaker before checking all electrical components and wiring connections. (See Figure 1-1). - Does the cabinet operate correctly after resetting the circuit breaker? If not proceed to next step.

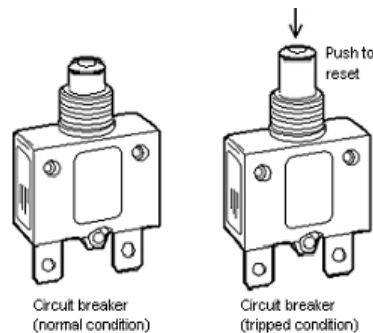


Figure 1-1

Improper connection	- Measure AC voltage between LIVE (RED) and NEUTRAL (BLUE) terminal blocks inside electrical box. See Figure 1-2. - Voltage must be within $\pm 10\%$ of the rated voltage - Refer to cabinet Serial Number Tag for required voltage - If the voltage is out of the range or there is no voltage, check cable connection on both sides of connector A. See Figure 1-3. 230 VAC at Connector A pin 1 and 3. Pin 5 is ground. - If you have voltage at Connector A, but not at the RED (LIVE) and BLUE (NEUTRAL) terminal blocks, the problem is between connector A and the terminal strips. - If voltage is not present at connector A, BUT is present at the female connector for the line cord at the top of the cabinet that the power cord is plugged into, the problem is between the female connector and the pins on Connector A.
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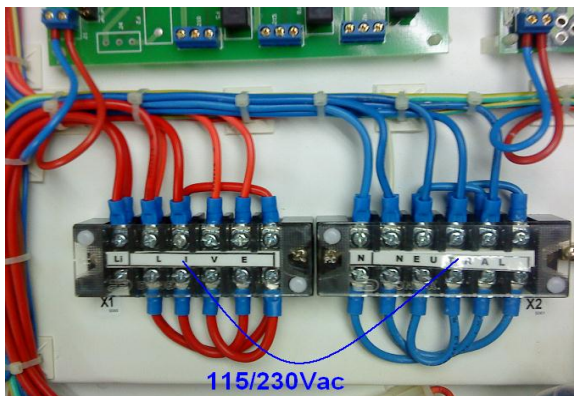


Figure 1-2

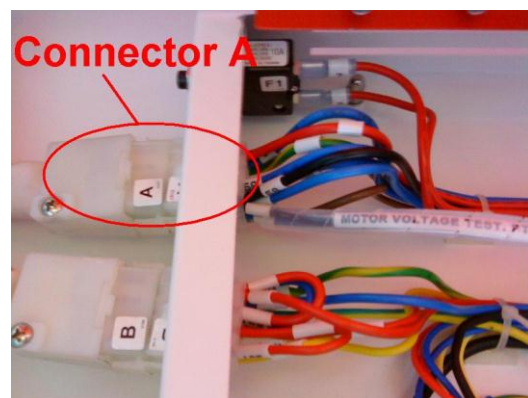
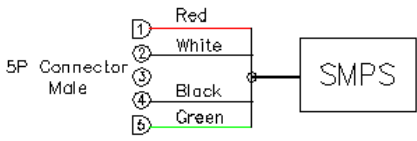
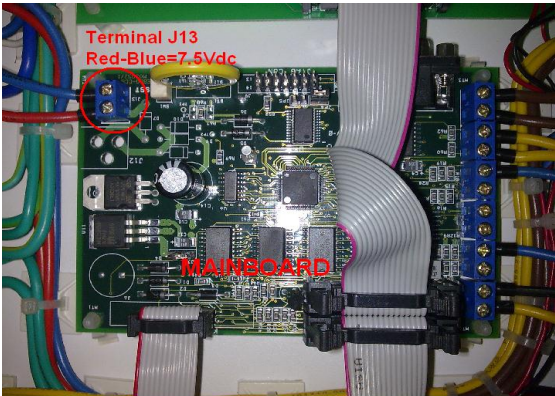
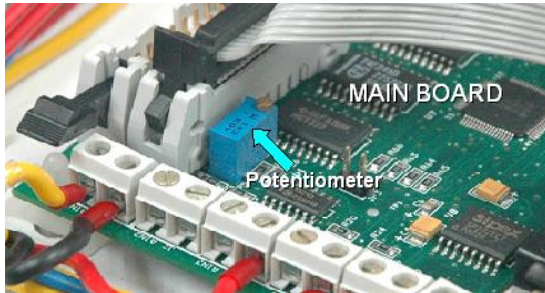


Figure 1-3

Defective power supply – Switch Mode Power supply (SMPS)	• Locate the SMPS (Power Supply) and 5 pin connector • On the BACK side of the 5 pin connector measure the DC voltage between Red (pin 1) and White (pin 2) Measure on the side away from the SMPS See Figure 1-4. • The voltage should be in range of +7.5VDC $\pm 10\%$. • If you do not have voltage measure the other side of the 5 pin connect • If out of range or no voltage, check incoming power to the SMPS (Molded cord) – check terminal where the cord is connected. The input of SMPS should be $\pm 10\%$ of the cabinet incoming voltage • If you have input voltage but no output voltage replace the SMPS • If input and output voltage is correct proceed to next step
SMPS output red-white is 7.5 V DC	  Figure 1-5
Connection problem to main board or from main board to display	• Measure the incoming voltage on the main board at terminal J 13 (Note polarity, blue cable closest to edge is negative -). See Figure 1-6. • Voltage should be between 6.75 – 8.25VDC. • If voltage is out of range or no voltage, check connection between SMPS and main board. • Check flat ribbon cable connection from main board to LCD/keypad membrane. NOTE: There are two ribbon cables from the main board and the display and key pad. The larger flat cable is for the Display. The smaller flat cable is for the LEDs/keypad membrane. • If the LCD Display is on, but not the LEDs in keypad membrane, check connection on the smaller Flat Ribbon cable. • If incoming voltage at J13 is correct and flat ribbon cable connections are connected but the LEDs on the keypad membrane and LCD display are still not on proceed to next step.
	Figure 1-6
Defective main board	• The main board is defective if the main board incoming supply is between 6.75 – 8.25VDC and: ○ All LED's on the control panel are off ○ The LCD is blank ○ No buzzer sound • If these conditions exist replace the main board, otherwise proceed to next step Note: when replacing main board, reconnect all wires correctly, any wrong wiring may result in damage

Problem 2: Blank LCD

Cause	Corrective Action
Connection problem	• Check LCD large Flat Ribbon Cable connecting the main board with the display at the main board end • Check if the cable has been inserted properly into its socket on the main board. This is a Keyed connector with locking arms. The arms should be pointed in the same direction as the cable. See Figure 2-1 below. • If the LCD Display is not on, check power to main board as detailed in Problem 1
 Figure 2-1	
Contrast problem	• Adjust the potentiometer on main board by rotating the top metal part using flat screw driver to achieve the best LCD contrast. Counter clock-wise direction will increase the contrast. See Figure 2-2. • If the LCD remains blank, replace it.
 Figure 7-2	
Defective LCD	• Connect a new LCD to the LCD port on main board. • If the new LCD functions properly, this indicates the old one is Defective. • If the new LCD does not work, replace the large Flat Ribbon Cable. • If the LCD still does not work replace the main board.

Problem 3: Inoperative buttons

Cause	Corrective Action
Connection problem	• Does the LCD display work? If not go to Problem 1 and make sure the main board has power. • Ensure that the small Flat Ribbon Cable is connected to the main board – See figure 3-1. The triangle sign on the female connector of the cable indicates PIN number 1. • Interface board and membrane/keypad are located behind the blue panel, underneath the metal light deflector. • Turn off the cabinet remove the bulbs and the clips that hold the bulbs. (Bulb connections pull off) - See Figure 3-2. • Check connections between the cable from the main board and the Interface board - See Figure 3-3 • Check the green plastic cable from the Interface board to the Display board - Figure 3-4

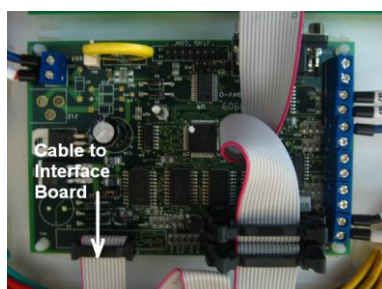


Figure 3-1

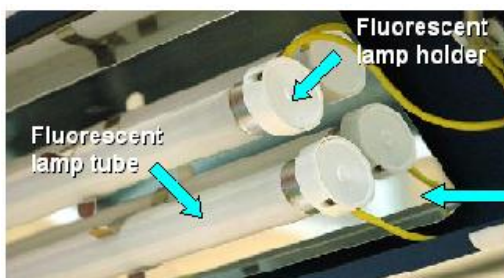


Figure 3-2

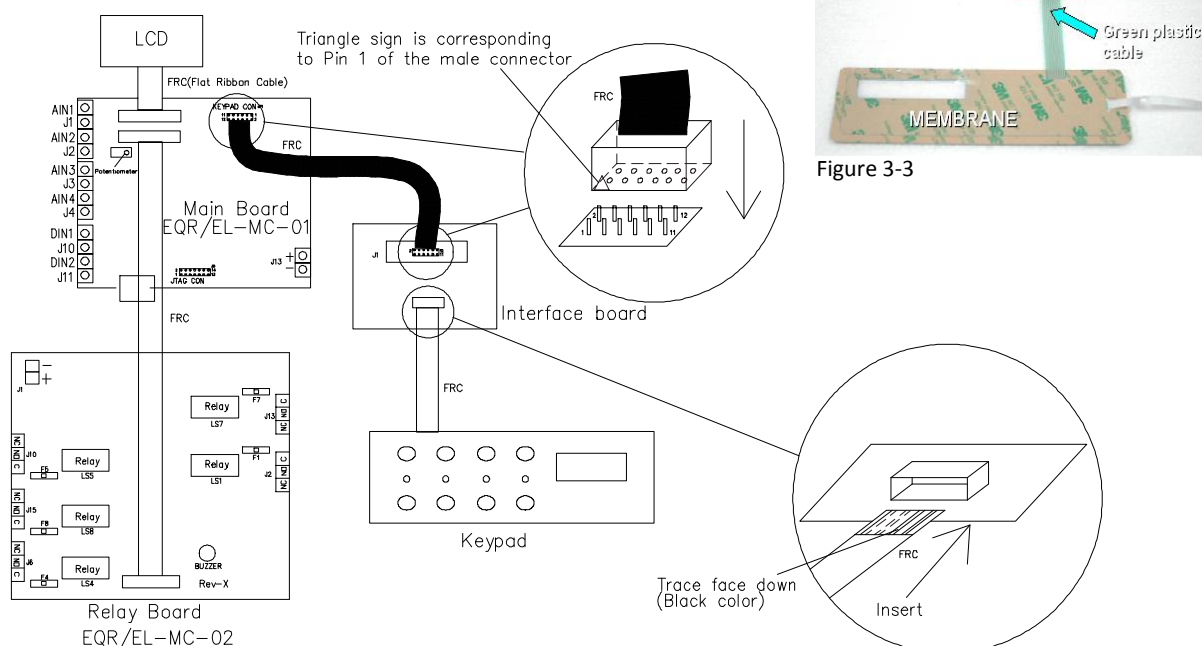


Figure 3-4

Defective Cable
and / or Interface
Board and / or
keypad

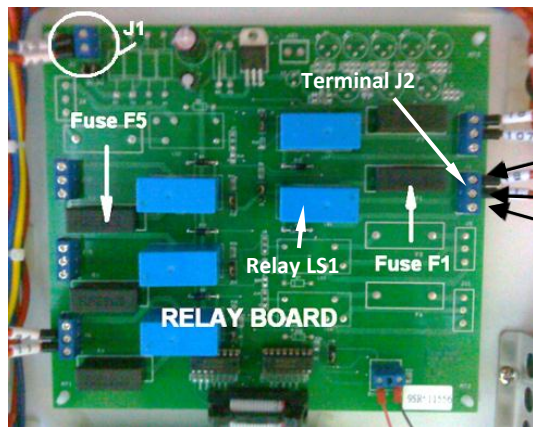
- Replace them one by one, to check which one(s) among them is/are Defective.
- Replace the Defective part(s).

Problem 4: Blower doesn't function

Cause	Corrective Action
Motor Blower Fan is not running	• Switch on the Fan by pressing Fan button on control panel. • Enter the Fan PIN number if required (default is 0001) • The LED for FAN should illuminate and the FAN should start. • If the FAN does not operate, proceed to next step. • If the LED on the cabinet front does not illuminate refer to Problem 1.
DC Voltage Connection problem to relay board	• Measure the incoming voltage on the Relay Board at terminal J 1 (Note polarity, BLUE cable closest to edge is negative -). See Figure 4-1. • Voltage should be between 6.75 – 8.25VDC. • If voltage is out of range or no voltage, check connection between SMPS (power supply) and relay board. • If voltage is correct, proceed to next step.

Fuse F1 is blown or circuit is not energized

- Check AC voltage coming to the Relay board.
- Ensure the Motor Blower FAN button and LED is energized.
- Locate LS1 circuit and measure AC voltage between large BLUE (Neutral) terminal block and the end terminal (with Red cable) on the three terminal strips (J2 on relay board). See Figure 4-1.
- If there is voltage to the end terminal (Terminal with cable) check the central terminal (Normally Open Circuit) to the BLUE (Neutral) terminal block.
- No voltage at the central terminal indicates a blown fuse or the circuit is not energized.
- Check Fuse F1 on relay board. See Figure 4-1 below.
- If fuse F1 is blown, as temporary solution, use F5 (spare) to replace F1.
- If fuse F1 is okay, check the voltage between the BLUE (Neutral) terminal block and the end terminal on the LS1 circuit (J2 on relay board)
- Voltage at the end terminal with no cable indicates the F1 fuse is good and the circuit is not energized.



Power in to FAN Circuit

Power out to K1

Normally closed relay connection
-not used

Figure 4-1

K1 Relay not energized or faulty

- Check voltage at the speed control on the motor voltage test points- Refer to Figure 4-2(E/S series model) and Figure 4-3(D/G series model).
- If the voltage is correct at the speed control proceed to next step. No voltage at the speed control indicates that K1 relay is not energized or the wiring between the Relay board and K1 is open.
- Check the voltage between the BLUE (Neutral) terminal block and NO terminal contact at K1 relay. Refer to Figure 4-4/4-5.
- Ensure that the motor blower switch in front keypad membrane is on.
- If voltage is present at K1, proceed to check the speed controller in next section. Otherwise, check all terminal connections to K1 relay.
- If connections on K1 relay are OK, visually inspect K1 relay for any burnt or flash marks. Refer to Figure 4-5.
- If burnt or flash marks are present, replace the relay



Figure 4-2



Figure 4-3

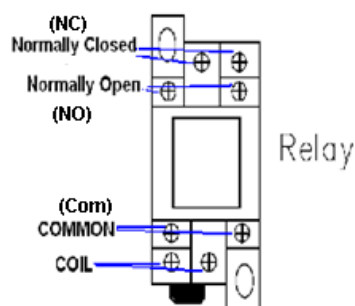


Figure 4-4

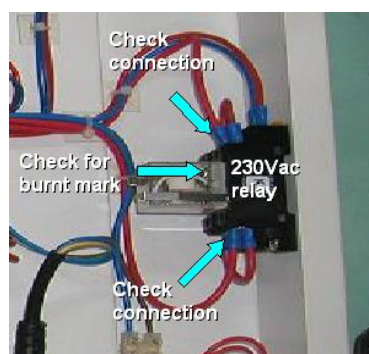


Figure 4-5

Defective motor speed controller

- Switch on the blower on the cabinet.
- Open electrical box and see Component Layout at beginning of this section to locate the speed controller. This is indicated by the N1 and N2 (D/G series models only) in the layout.
- If you followed the steps outlined above and still the blower doesn't work, Switch off the cabinet.
- Bypass the speed controllers by adding jumper cable across two cables going to N1 and N2 (D/G series models only). See Figure 4-8 below.
- Switch on the cabinet. The speed controller is defective when the fan operates properly. Replace the defective speed controller.
- If the fan does not operate, proceed to next step



Figure 4-6



Figure 4-7

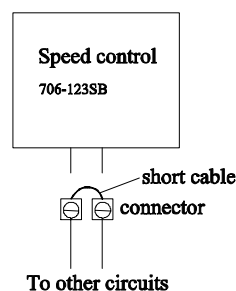
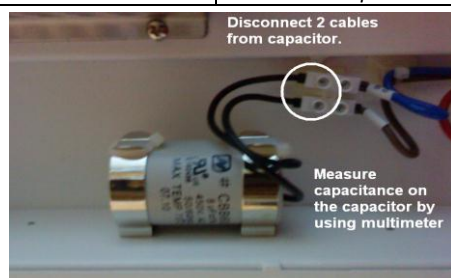


Figure 4-8

Defective capacitor

- Switch the cabinet off.
- Locate the capacitor and disconnect two cables from the capacitor. Refer to Figure 4-9
- Using a capacitance meter or a DVM set to capacitance measurement. Record the value between two capacitor cables.
- If the value is out of given ranges on table 1, replace capacitor.
- If the capacitance is within the given ranges proceed to next step.

Warning: The capacitor may still have some electrical charges if the cabinet was on prior to performing this check. Wait for 1-2 minutes and check the capacitor voltage using a voltmeter to ensure the capacitor is discharged (voltage less than 5VAC) prior to disconnecting the capacitor.



	Capacitor 1	Capacitor 2
AC2- _ ESDG1/3	7.5-8.5uF/ 9-11uF	3.5-4.5uF
AC2-2E2, AC2-3E2, AC2-4E2, AC2-6E2	19-21uF	---
AC2-2S2, AC2-3S2, AC2-4S2, AC2-6S2	19-21uF	---
AC2-5E2, AC2-5S2	28-32uF	---

Note: 6 feet models have 2 pcs of capacitor 1 for additional blower required.

Figure 4-9

Table 1

Auto-thermal cut-off	• Check the Fan for overheating – The motor has a thermal cut out built-in. • Wait 60 minutes with the FAN turned off and then try to restart. • If the FAN restarts determine why there is excessive heat in the cabinet. • If the FAN does not restart proceed to the next step.
Motor failure	<u>WARNING:</u> The cabinet MUST be decontaminated before opening the Red Panel. • Check for physical damage. • Will the motor rotate? • Check wiring • Replace the blower.

Problem 5: Airflow Failure (AIRFAIL) – alarm is triggered

Cause	Corrective Action
External air interference	• Ensure that there are no external sources of airflow disturbance close to the sensor. Check vents, lights, ceiling too close, etc. • If there is no external air interference, proceed to next step.
Blocked cabinet grille	• Ensure that the air grilles inside the cabinet are not blocked and that the cabinet is not excessively loaded. • If there is no blockage in air grilles, proceed to next step.
Low building supply voltage (if new cabinet, check this first)	• Open electrical box and find motor voltage Test Point shown in Figures 4-2/4-3. • <u>NOTE:</u> A qualified Certifier should make all voltage adjustments • For a new cabinet, if the motor voltage is lower than the Nominal Voltage value recorded in the factory test report, adjust the speed controller to get output voltage to blower as specified in the Test Report – Test Conditions Documentation Sheet. • For cabinet that has been used for more than 1 year, refer to last motor Nominal Voltage from last certification report or if not available, measure the actual airflow on cabinet and increase motor voltage accordingly to achieve nominal airflow velocity. • If supply voltage is same as Nominal voltage, proceed to next step.
Defective airflow sensor power supply –Switch Mode Power supply (SMPS)	• Cabinet must be turned on to perform this test • Locate the 5 pin connector. • On the BACK side of the 5 pin connector measure the DC voltage between Green (pin 5) and Black (pin 4) Measure on the side away from the SMPS See Figure 1-4 and 1-5. • The voltage should be in range of +12VDC $\pm 10\%$. • You do not have to measure voltage on the other side of the 5 pin connect • If out of range, check incoming power to the SMPS Molded cord – check terminal where the cord is connected. The input should be $\pm 10\%$ of the cabinet voltage • If you have input voltage but no output voltage replace the SMPS.
Cabinet requires the air flows to be set	• Refer to the Test Report for this model and set the air flow values to the required values. This information is also contained on the label at the bottom of the BLUE front panel on the Left side as you face the cabinet
Filter loaded or wrong speed controller setting	• Plug in the voltmeter to the Motor Voltage Sampling Port. • Measure the actual airflow velocity using anemometer or flow hood. If actual airflow is okay but LCD still shows AIRFAIL, proceed to next step. If actual airflow is not okay, please adjust motor speed controller accordingly until alarm is turned off and the LCD shows nominal airflow reading. After this, if LCD still shows AIRFAIL, proceed to next step. • The sensor will take about 2-3 minutes before it can register a new airflow setting. • <u>Note:</u> The cabinet must be certified at least annually. • If the blower is already operating at maximum voltage and the airflow alarm is still triggered due to filter loaded, it's time to change the filter. • If filter is not loaded, proceed to next step.

Faulty/ inaccurate calibration	- Re-calibrate the microprocessor. Follow the calibration procedure in the test report. Warning: <i>To be carried out only by an authorized person.</i> <u>CHECKING CALIBRATION DATA</u> - After calibration is done, go to main display by pressing MENU button twice. - Press SET/Diagnostic button, LCD will display the mode and software version that is currently being used on the cabinet. Example: DIAGNOSTIC MODE: NORMAL CP104D VERSION 1.5 - Press DOWN button until you find the following: -TEMPERATURE: Shows actual ambient temperature - ADC IFF: ADC value for Fail Point Inflow – calculated using offset based on Inflow Nominal Point. - ADC IFN: ADC value for Nominal Point Inflow – set during sensor calibration. - ADC IFA: ADC value for Actual Inflow – showing real time sensor reading. - ADC IF0: ADC value for factory calibrated Zero Point Inflow (no inflow)-set during zero calibration. - ADC IF1: ADC value for factory calibrated Fail Point Inflow. - ADC IF2: ADC value for factory calibrated Nominal Point Inflow. - ADC DFA: ADC value for Actual Downflow – showing real time sensor reading. - ADC DF0: ADC value for factory calibrated Zero Point Downflow (no downflow). - ADC DFN: ADC value for Nominal Point downflow – based on field calibration. - CONSTANT: value for Inflow sensor constant - keyed in during sensor calibration. - CALIB TEMP: Temperature when the factory calibration was performed. - ADC TEMP: ADC value for temperature. <i>Note: Depending on preset unit at SETTINGS>MEASUREMENT UNIT> (Metric or Imperial), the units for temperature and velocity will change accordingly. For Metric-°C, m/s while for Imperial-°F, fpm. Factory setting is at Metric.</i> In order to prevent any AIRFAIL or unstable velocity displayed on LCD problem, please ensure the following is done after the calibration: 1. CONSTANT value is correct. Check it with constant written on airflow sensor body or inside Replaceable Component Record List which comes with the test report. 2. TEMPERATURE shows room temperature. If not, refer to next possible cause, part B. 3. ADC IF0 < ADC IF1 < ADC IF2. If not please re-do calibration in correct sequence: SET CONSTANT → SET ZERO → CALIB. If CALIBRATION ERROR is encountered, please refer to next possible cause, part A. 4. ADC DF0 < ADC DFN. If not please re-do calibration in correct sequence: SET CONSTANT → SET ZERO → CALIB. If CALIBRATION ERROR is encountered, please refer to next possible cause, part A. 5. Just after calibration, ADC IFA value should be close to ADC IFN value. If not, please adjust the speed controller to make both values closer by at least +/- 20 units.
Sensor Failure / Sensor Misalignment	<u>A. Air Flow Sensor failure / misalignment</u> Airflow sensor the top of the cabinet (E/S series model) or inside the unit below the top filter (D/G series model). Airflow sensor for D/G series models can be accessed from the back of the unit. See Figure 5-1 below. It is a stainless steel tube with 2 round holes facing up.

Important to check:

1. Ensure that the sensor area is not blocked at all and that its through-holes are perpendicular to the filter's surface.
 2. Exhaust sensor is attached tightly to the box.
 3. There is no gap between sensor box and filter surface.
 4. Sensor box is installed tightly to the cabinet.
- Turn off the cabinet.
 - Open the front panel and locate electrical box behind it.
 - Open electrical box and see Component Layout at the beginning of this section to locate the main board inside electrical box.
 - Using multimeter, check the exhaust sensor's output voltage (DC) at channel AIN1(+) and J1(-) on main board (See Figure 5-2 below).
 - The airflow sensor voltage should increase if airflow is increased and decrease if airflow is decreased.
 - If your observations are different, check airflow sensor connection on top of the unit (see Figure 5-1) and at connector D pin 9,10,11,12 on electrical panel for any bad/loose connection.
 - If connections are okay but sensor is still not working properly, replace it.
 - If airflow sensor is working properly, proceed to next step.

B. Temperature Sensor Failure

- Temperature sensor is located on top of the unit, close to exhaust airflow sensor, and attached on the white metal box. See Figure 5-3.
- Using multimeter, check the temperature sensor's output voltage (DC) at channel AIN4(-) and J4(+) on main board See Figure 5-2.
- 0.01VDC should represent one degree Celsius. For example, if output is 0.25VDC, it indicates temperature of 25 °C. Tolerance of $\pm 1^{\circ}\text{C}$ is acceptable.
- Replace temperature sensor if the reading is wrong.
- If temperature sensor is working properly, proceed to next step.

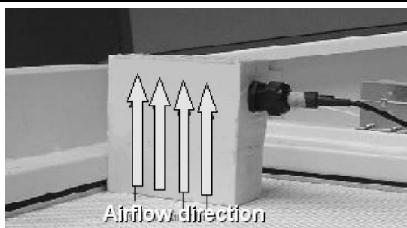


Figure 5-1

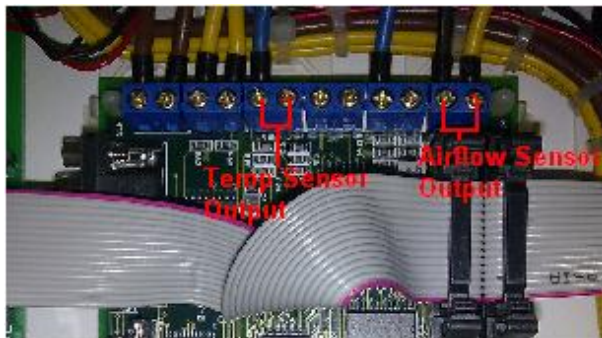


Figure 5-2

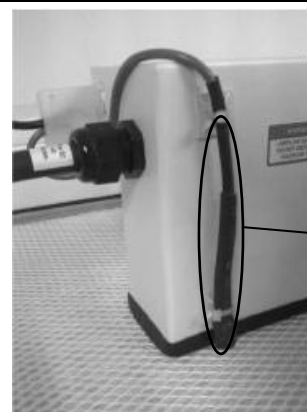


Figure 5-3

Problem 6: Excessive Blower Noise

Cause	Corrective Action
Resonance	<i>NOTE: Requires a Certifier</i> • Locate the motor speed controller • Measure the motor voltage and record this number • Increase the motor speed by 5 – 10 VAC. Does the noise change or go away? • If the noise is gone, measure the actual airflow velocity. Requires a Certifier ○ If the velocity is still in the acceptable range, maintain it. ○ If velocity is out of acceptable range, or if noise persists, go to next step.
Loose motor or impeller wheel mounting	Note: Decontaminate cabinet first before accessing the blower • Open the blower access panel and check if the blower mounting bolts are tight • Does the motor rotate freely without noise? • If motor is physically damaged, replace it.

Problem 7: Light always OFF

Cause	Corrective Action
Sash in SASH ALARM state	• Is the Light LED on the front panel ON? • If not press the Light button and make sure the sash is in the Normal operating position (Ready Position Normal Operating height) Note: The sash must be at the Normal Operating position • Is the cabinet in Warm Up? Note: The fluorescent light will not light if the cabinet is in Warm Up unless the cabinet is in Quick Start Mode • Move the sash to Ready position (normal operating height). • Switch on the light by pressing LIGHT button on the membrane. • If the LED is ON the keypad and main board are functioning correctly • If fluorescent light does not light with the window in the proper position proceed to next step • If the LIGHT LED still does not light skip to Ready magnetic switch Issues
Burned out fluorescent tube	• Replace the faulty fluorescent tube. • Fluorescent tubes are located inside the blue panel. • The white lamp holder can be pulled off from the tubes.
Defective Fluorescent ballast or Relay Board issues	• Check voltage coming to the Relay board • Locate LS7 circuit and measure AC voltage between BLUE (NEUTRAL) terminal block and the end terminal (with Red cable) on the three terminal strip (J13 on relay board) • If there is voltage to the end terminal (Terminal with cable) check the central terminal (Normally Open Circuit) to the BLUE (NEUTRAL) terminal block. • No voltage at the central terminal indicates a blown fuse or the circuit is not energized • Check Fuse F7 on relay board. See Figure 7-1 below. • If fuse F7 is blown, as temporary solution, use F5 (spare) to replace F7. • If fuse F7 is okay, check the voltage between the BLUE (NEUTRAL) terminal block and the end terminal on the LS7 circuit (J13 on relay board) • Voltage at the end terminal with no cable indicates the F7 fuse is good and the circuit is not energized • Make sure the LIGHT LED is on. • If the ballast has power and the bulbs are new the problem is either connections or the ballast. • Check Connector C connections. If there are no loose terminals replace the ballast

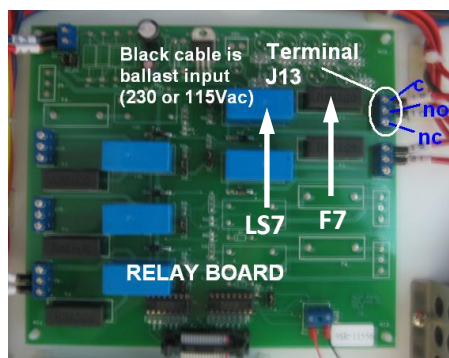


Figure 7-1

Ready magnetic switch Issues

- With the LIGHT LED ON and the sash at the Normal operating position (Ready)
- Does the Display indicate SASH: OK or SASH: NO!
- SASH: NO indicates the sash is not at the proper position and the LIGHT LED should not be on. This indicates a main board problem or a magnetic switch detection problem.
- To access the magnetic switches for the sash positions remove the Right sash window profile cover as you face the cabinet.
- There are 3 magnetic switches inside the right profile. See Figure 7-2 below. The one in the middle is for Ready position.
- There is a magnet attached to the glass beside the middle switch.
- Shift the switch or magnet position so the distance between them is between 10-13 mm (3/8 to 1/2") as explained in Figure 7-2 below. If the distance is too far, the switch may not be able to detect the magnet.
- If the LCD still displays "SASH: NO!", the switch may be defective or there is a wiring connection problem. To check the connections proceed to the next step.

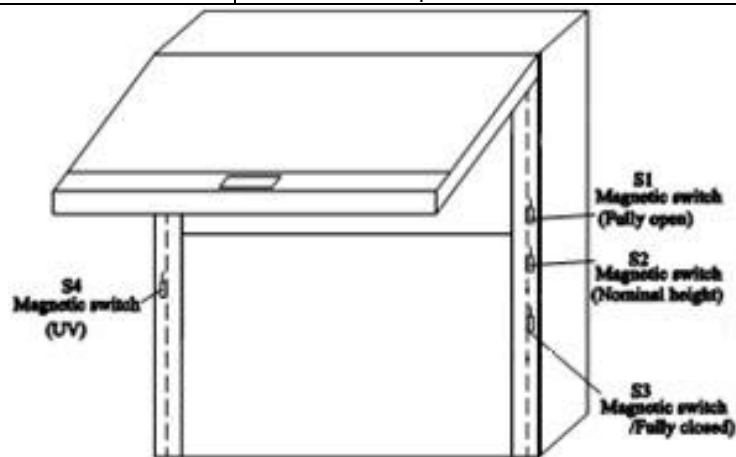


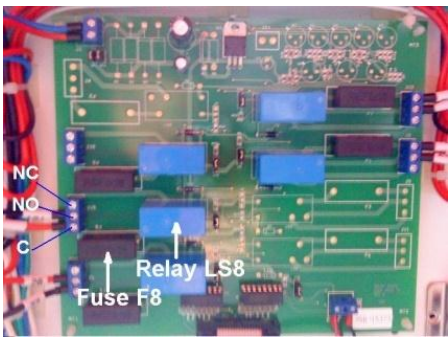
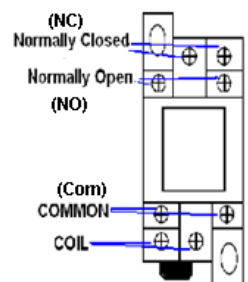
Figure 7-2

Connection Problem

- Locate Connector C and D and check male and female side for any bad connection.
- If the fluorescent lamp still does not light with the LIGHT LED ON return to start of Problem 7 and repeat the troubleshooting process.

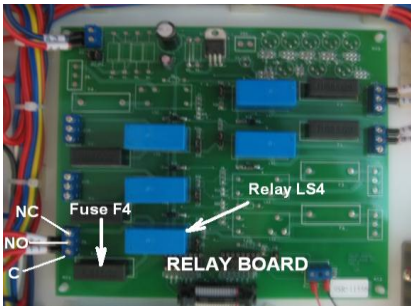
Problem 8: UV Light always OFF

Cause	Corrective Action
Sash not in UV state	• Lower the sash to UV mode position. • If SASH FULLY CLOSED is not displayed on the LCD, please refer to the Magnetic Switch troubleshooting section. • Switch on the UV lamp by pressing the UV button. • If SASH FULLY CLOSED is displayed on LCD but UV is not ON after pressing UV button, refer to the Magnetic Switch troubleshooting section.

Faulty UV tube	Replace the faulty UV tube.
Faulty UV ballast	- Check voltage coming to the Relay board - Locate LS8 (J15 Terminal) circuit and measure AC voltage between large BLUE (Neutral) terminal block and the end terminal (with Red cable) on the three terminal strip (J15 on relay board). - If there is NO Power to the end terminal (Terminal with cable) refer to the next step NO power to UV Relay circuit LS8. - If there IS voltage to the end terminal (Terminal with cable) check the central terminal (Normally Open Circuit) to the BLUE (Neutral) terminal block. - No voltage at the central terminal indicates a blown fuse or the circuit is not energized. - Check Fuse F8 on relay board. See Figure 8-1 below. - If fuse F8 is blown, as temporary solution, use F5 (spare) to replace F8. - If fuse F8 is okay, check the voltage between the BLUE(NEUTRAL) terminal block and the end terminal on the LS8 circuit (on J15 terminal of relay board) - Voltage at the end terminal with no cable indicates the F8 fuse is good and the circuit is not energized - Make sure the UV LED is on. - If the ballast has power and the UV lamp is new, the problem is either cable connections or the UV ballast. - Check Connector B cable connections. If there are no loose terminals replace the UV ballast.
No Power to UV Relay circuit LS8 and K2 relay	- No power to LS8 indicates K2 Relay is open. - Check magnetic UV interlock switch on Left side (as you face the cabinet) of sash. - Check the AC voltage to and from the K2 relay - No voltage indicates a wiring issue between the RED (Live) power in and the K2 relay. - If voltage to the K2 relay is present, but no voltage out of the K2 relay, this indicates the relay is not energized or defective. - Check the DC voltage to the coil of the K2 relay. Voltage should be 12VDC +/- 10% - No voltage indicates the magnetic switch on the Left side is not closed. Check the wiring to the switch Connector D-6 and D-3. - To simulate a closed switch jumper between connector D-6 and D-3 at Connector D - If the relay does not energize check the wiring from the K2 coil to Connector D and the neutral wiring from K2 to the DC Power supply. - If wiring connections are OK, visually inspect K2 relay for any burnt or flash marks. - If burnt or flash marks are present, replace the relay. - If no burnt or flash marks are found, turn off the cabinet. - Disconnect relay cables and check for the continuity at K2 relay terminals. See figure 8-2. NC to COM has continuity while, NO to COM doesn't have continuity. Replace the relay if any of the terminals are found with wrong continuity configuration.
 Figure 8-1  Figure 8-2	

UV magnetic switch is defective or misaligned	• Move sash to Fully Closed position. The LCD should show SASH: FULLY CLOSED. • If the LCD display shows "SASH: NO!" the sash is not fully closed. • Check the magnetic switches. There are 3 magnetic switches inside the right profile. See Figure 7-2 above. The bottom one is for UV Mode position. • There is a magnet attached to the glass beside the bottom switch. • Shift the switch or magnet position so the distance between them is between 10-13 mm (3/8" to 1/2") as explained in Figure 7-2 above. If the distance is too far, the switch may not be able to detect the magnet. • If the LCD still showing "SASH: NO" check the connections at Connector D pins D-4 and D-5 • To simulate a closed U/V Switch jumper between Connector D pins D-5 and D-4 • If this does not turn on the UV go back to the start of this procedure and check it again
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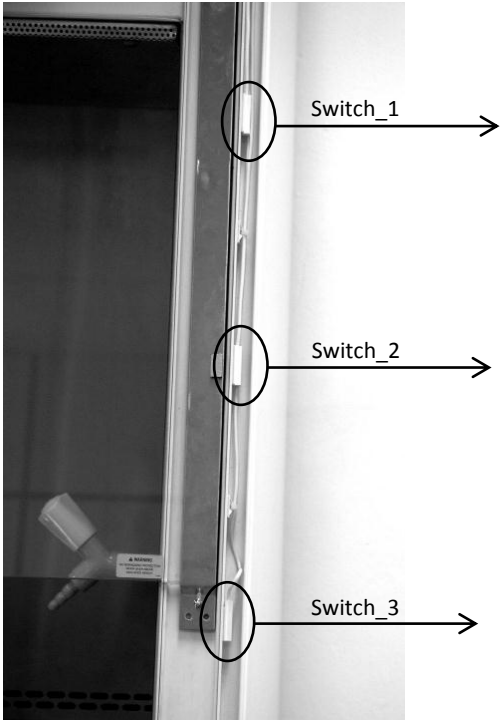
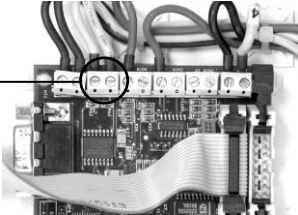
Problem 9: Electrical socket always OFF

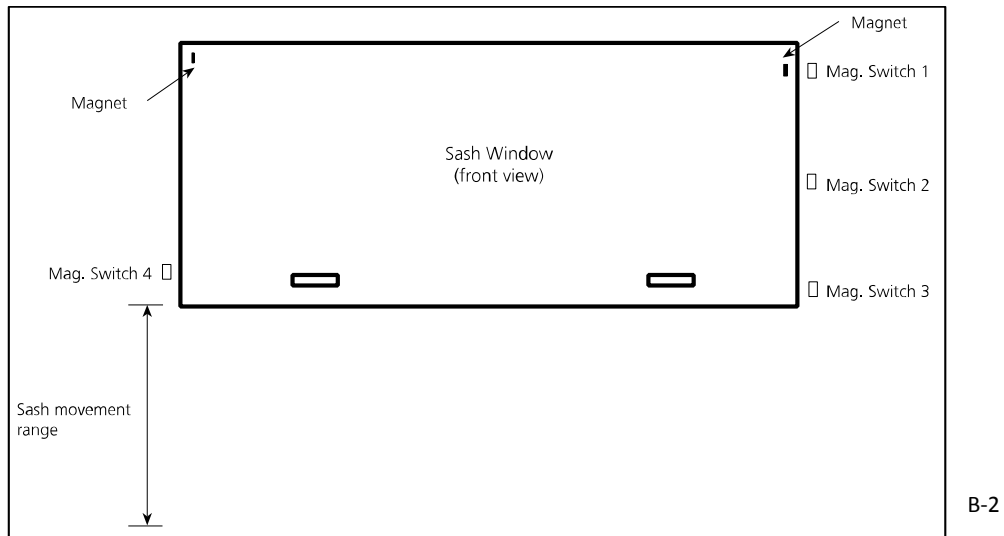
Cause	Corrective Action
Connection Problem	• Is the OUTLET LED Illuminated? If not press the Outlet button at the keypad membrane in front panel. • Check voltage coming to the Relay board. • Locate LS4 (J6 Terminal) circuit and measure AC voltage between Large BLUE (Neutral) terminal block and the end terminal (with Red cable-COM) on the three terminal strip (J6). • If there is voltage to the end terminal (with Red cable-COM), check the central terminal (Normally Open circuit) to the BLUE (Neutral) terminal block. • No voltage at the central terminal (Normally Open circuit) indicates a blown fuse or the circuit is not energized. • Check Fuse F4 on relay board. See Figure 9-1 below. • If fuse F4 is blown, replace with F5 fuse. • If fuse F4 is OK, check the voltage between the BLUE (NEUTRAL) terminal block and the end terminal (COM) on the LS4 circuit (J6 on relay board). • Voltage at the end terminal (Normally Closed circuit) with no cable indicates the F4 fuse is good and the circuit is not energized. Make sure the OUTLET LED is on. • If there is power to the relay and it is energized Check voltage across Connector B pin 1 to 2 and pin 4 to 5. • If there is power through Connector B pins, remove socket outlets from wall. • Check incoming power to the plug in the cable to the outlet • No power indicates a wiring issue. Recheck voltage from Connector B pins. • Check for loose or faulty connection between the power cord, IEC inlet and Connector B.
 Figure 9-1	
Faulty electrical socket	• Socket is located inside the work zone • Check electrical socket connection. • If connection is correct but socket has no output, replace electrical socket.

Problem 10: Contaminated Sample/Lab

Cause	Corrective Action
Blocked air grille/ Cabinet overloaded with too many items.	Note: Contaminated samples are normally the result of any of the following: - Poor Technique of the user or lack of training. - Samples being contaminated in the incubator or somewhere other than the BSC. Items to check on the BSC • Make sure that the front and back air grilles are not blocked. • Remove all equipment and other items from the cabinet and wipe down the cabinet including the area under the work surface. • Wipe down everything that is returned to the BSC. • If the contamination problem continues have the cabinet certified including air flows and filter leak tests.

Software Troubleshooting

Error Code	Corrective Action
Sash: Error Position	• Magnetic switches are located inside right profile cover. See drawing B-1 below.
  7.5VDC  Shorted  Shorted B-1	



Magnetic Switch 1	Magnetic Switch 2	Magnetic Switch 3	Magnetic Switch 4	Description
Close	Open	Open	Open	Sash is fully opened, ALARM is given. ALARM can be muted.
Open	Close	Open	Open	Cabinet sash is at nominal height, ready to use.
Open	Open	Close	Close	Sash is fully closed; UV can be operated.
Open	Open	Open	Open	SASH is at unsafe state, ALARM is given. ALARM cannot be muted.
Rest Conditions				SASH:ERROR POSITION detected

Table 2

SENSOR
UNCALIBRATED

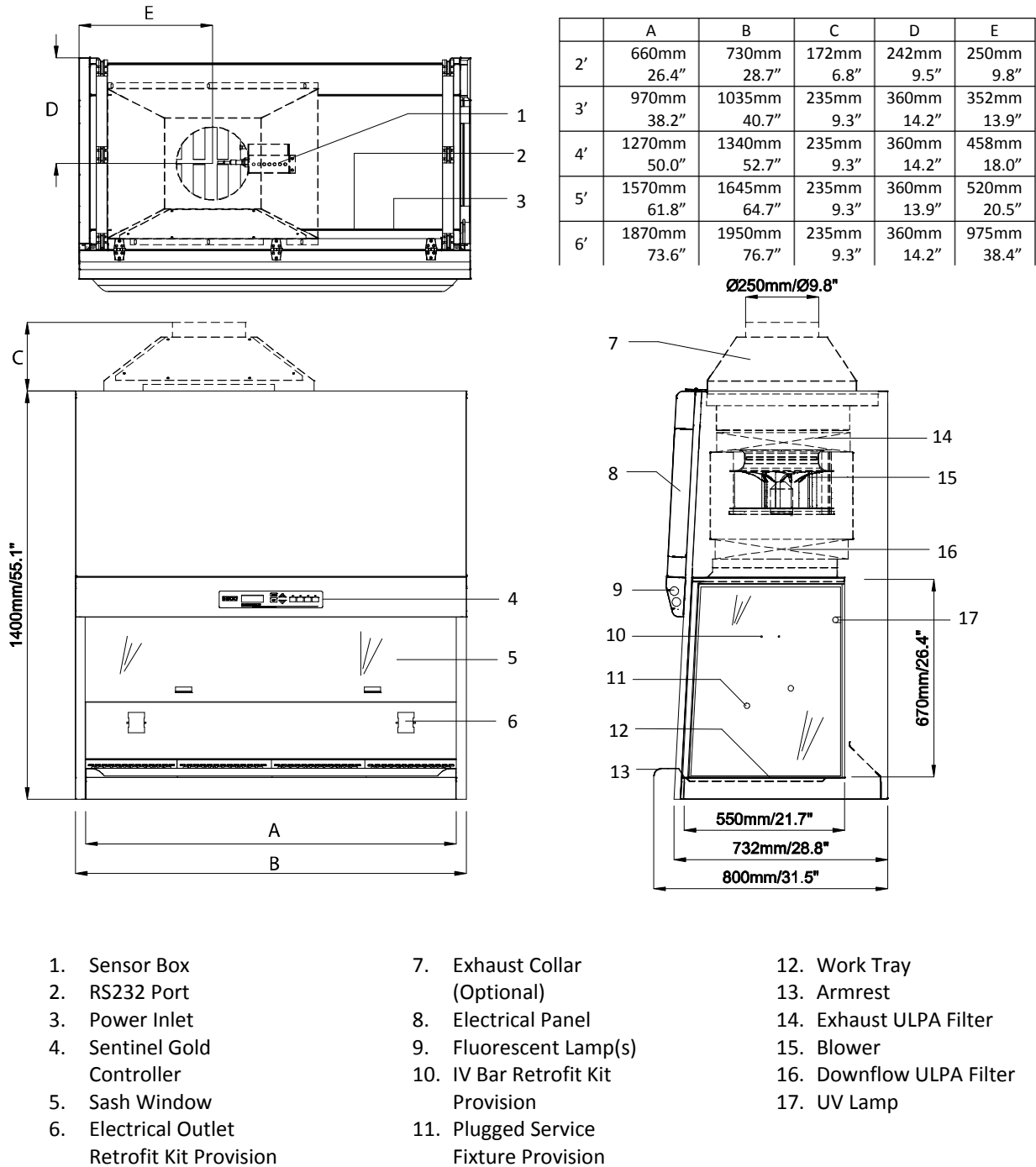
- Calibrate the controller. Refer to test report to calibrate.

Sash Position	Function Available	Normal Or Quickstart Mode and Airfail Alarm On	Normal Or Quickstart Mode and Airfail Alarm Off	Maintenance Mode
READY	Sash Position Detection	Yes	Yes	Yes
	Fan Control	Yes, with WARM UP & PURGING time, FAN PIN required	Yes, with WARM UP & PURGING time, FAN PIN required	Yes, without WARM UP & PURGING time, no PIN required
	Light Control	Yes	Yes	Yes
	Socket Control	Yes	Yes	Yes
	UV Control	Interlocked	Interlocked	Interlocked
	MENU Access	Yes, USER or ADMIN PIN required	Yes, USER or ADMIN PIN required	Yes, no PIN required
	Pressing Set button	Complete Diagnostic Message	Complete Diagnostic Message	Complete Diagnostic Message
	Timer	Yes	Yes	No
	Current Time Display	Yes	Yes	Yes
	Air Velocity Display	Yes	Yes	Yes
	If not calibrated, displaying "Sensor Uncalibrated"			
	Air Velocity Display Status	Yes	Yes	No
SASH ALARM	Air Fail checking	Yes, Alarm and display alert if air fails	No	No
	Sash Position Detection	Yes	Yes	Yes
	Current Time Display	Yes	Yes	Yes
	Sash Alarm	Yes, not mutable	Yes, not mutable	Not Applicable
	Fan Control	Yes, without WARM UP & PURGING time, no PIN required	Yes, without WARM UP & PURGING time, no PIN required	Yes, without WARM UP & PURGING time, no PIN required
	Light Control	No	No	Yes
	Socket Control	Yes	Yes	Yes
	UV Control	Interlocked	Interlocked	Interlocked
	Air Velocity Display	Yes	Yes	Yes
	Air Velocity Display Status	Yes	Yes	No
FULLY OPEN	Air Fail checking	Yes, display alert if air fails	No	No
	Sash Position Detection	Yes	Yes	Yes
	Current Time Display	Yes	Yes	Yes
	Alarm	Yes, mutable for 5 minutes	Yes, mutable for 5 minutes	Not Applicable
	Fan Control	Yes, with WARM UP & PURGING time, FAN PIN required	Yes, with WARM UP & PURGING time, FAN PIN required	Not Applicable
	Light Control	Yes	Yes	Yes
	Socket Control	Yes	Yes	Yes
FULLY CLOSED	UV CONTROL	Interlocked	Interlocked	Interlocked
	Sash Position Detection	Yes	Yes	Yes
	SWITCH OFF Fan requested	Yes	Yes	No
	Fan Control	Interlocked	Interlocked	Yes
	Light Control	Interlocked	Interlocked	Yes
	Socket Control	Yes	Yes	Yes
	UV Control	Yes	Yes	Interlocked

Chapter 9 – Engineering Details

9.1 AC2-_E_Series

9.1.1 Engineering Drawing



9.1.2 General Specification

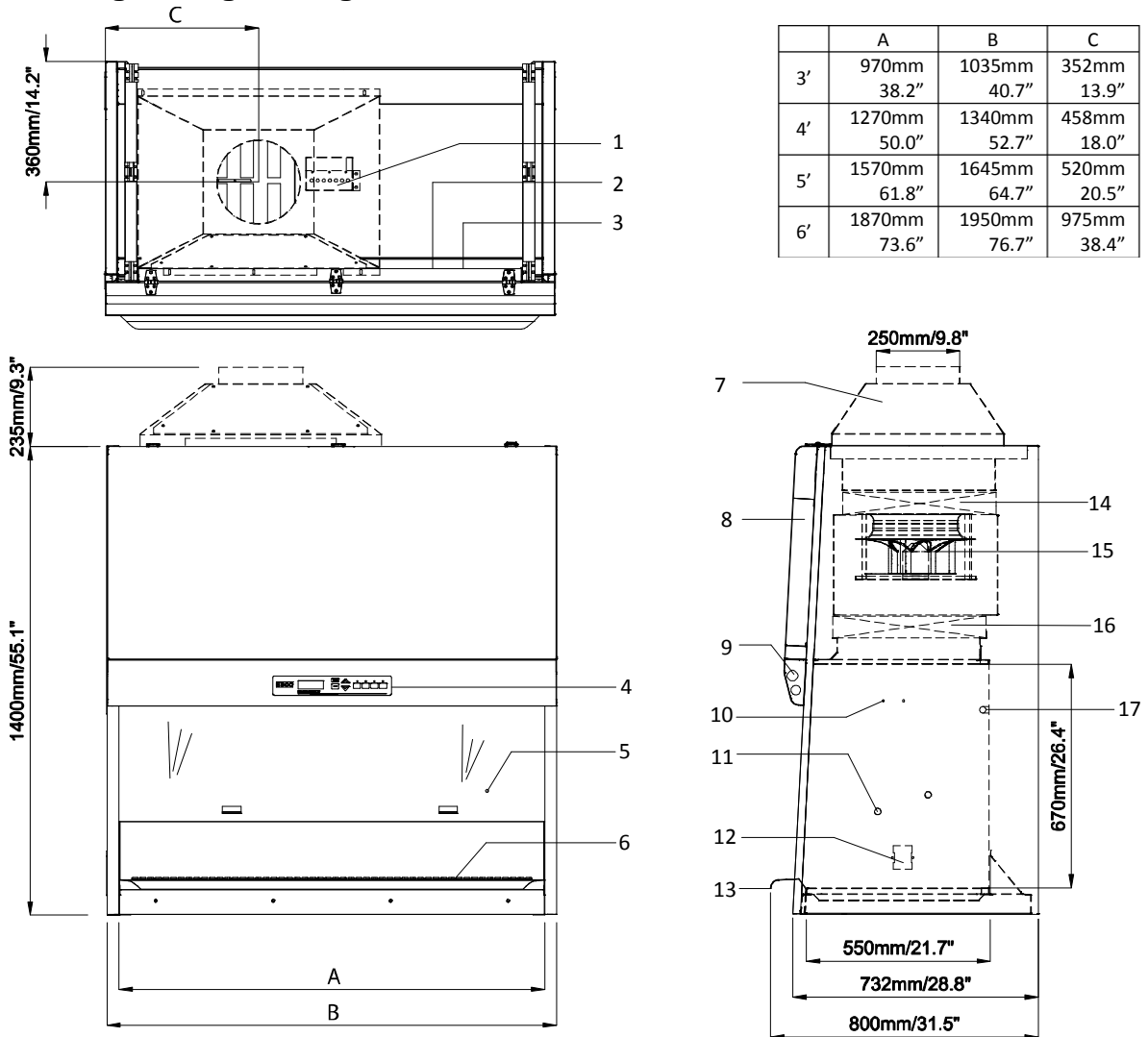
		AC2-2E_	AC2-3E_	AC2-4E_	AC2-5E_	AC2-6E_
External Dimensions (W x D x H)		730 x 800 x 1400 mm	1035 x 800 x 1400 mm	1340 x 800 x 1400 mm	1645 x 800 x 1400 mm	1950 x 800 x 1400 mm
		28.7" x 31.5" x 55.1"	40.7" x 31.5" x 55.1"	52.7" x 31.5" x 55.1"	64.7" x 31.5" x 55.1"	76.7" x 31.5" x 55.1"
Gross Internal Dimensions (W x D x H)		660 x 560 x 670 mm	970 x 550 x 670 mm	1270 x 550 x 670 mm	1570 x 550 x 670 mm	1870 x 550 x 670 mm
		26.4" x 22.0" x 26.4"	38.2" x 21.7" x 26.4"	50.0" x 21.7" x 26.4"	61.8" x 21.7" x 26.4"	73.6" x 21.7" x 26.4"
Usable Work Area		0.29 m ² (3.1 ft ²)	0.42 m ² (4.6 ft ²)	0.56 m ² (6.0 ft ²)	0.71 m ² (7.6 ft ²)	0.85 m ² (9.1 ft ²)
Avg. Airflow Velocity	Inflow	0.45 m/s (90 fpm) at initial setpoint				
	Downflow	0.30 m/s (60 fpm) at initial setpoint with uniformity of better than +/- 20%				
Airflow Volume	Inflow	185 m ³ /h (111 cfm)	270 m ³ /h (162 cfm)	356 m ³ /h (213 cfm)	440 m ³ /h (263 cfm)	524 m ³ /h (313 cfm)
	Downflow	385 m ³ /h (230 cfm)	563 m ³ /h (337 cfm)	741 m ³ /h (443 cfm)	916 m ³ /h (548 cfm)	1091 m ³ /h (652 cfm)
	Exhaust	185 m ³ /h (111 cfm)	270 m ³ /h (162 cfm)	356 m ³ /h (213 cfm)	440 m ³ /h (263 cfm)	524 m ³ /h (313 cfm)
	Required Exhaust With Optional Thimble Exhaust Collar	260 m ³ /h (153 cfm)	320 m ³ /h (189 cfm)	538 m ³ /h (317 cfm)	615 m ³ /h (362 cfm)	823 m ³ /h (485 cfm)
	Static Pressure For Optional Thimble Exhaust Collar	28 Pa / 0.11 in H ₂ O	29 Pa / 0.11 in H ₂ O	31 Pa / 0.12 in H ₂ O	35 Pa / 0.14 in H ₂ O	47 Pa / 0.18 in H ₂ O
ULPA Filter Efficiency	Downflow	>99.999% at 0.1 to 0.3 micron as per IEST-RP-CC001.3 USA				
	Exhaust	>99.999% at MPPS as per EN 1822 (H-14) EU				
Sound Emission *	NSF / ANSI 49	<62 dBA	<61 dBA	<62 dBA	<62 dBA	<63 dBA
	EN 12469	<59 dBA	<58 dBA	<59 dBA	<59 dBA	<60 dBA
Fluorescent Lamp Intensity		>900 Lux (> 84 foot candles)	>1130 Lux (>105 foot candles)	>1280 Lux (>119 foot candles)	>1050 Lux (>97 foot candles)	>1220 Lux (>113 foot candles)
Cabinet Construction	Main Body	1.2 mm (0.05") 18 gauge electro-galvanized steel with white oven-baked epoxy-polyester Isocide antimicrobial powder coated finish				
	Work Zone	1.5 mm (0.06") 16 gauge stainless steel, type 304, with BA finish				
	Side Walls	UV absorbing tempered glass, 5 mm (0.2"), colorless and transparent				
Electrical	220-240V, AC, 50Hz, 1 ϕ	AC2-2E1	AC2-3E1	AC2-4E1	AC2-5E1	AC2-6E1
	110-130V, AC, 60Hz, 1 ϕ	AC2-2E2	AC2-3E2	AC2-4E2	AC2-5E2	AC2-6E2
	220-240V, AC, 60Hz, 1 ϕ	AC2-2E3	AC2-3E3	AC2-4E3	AC2-5E3	AC2-6E3
Net Weight **		160 kg (353 lbs)	177 kg (390 lbs)	203 kg (447 lbs)	251 kg (552 lbs)	299 kg (658 lbs)

* Sound emission test is conducted in an open field condition/anechoic chamber

** Cabinet only (excluding retrofit kit & support stand)

9.2 AC2-_S_ Series

9.2.1 Engineering Drawing



- | | | |
|-----------------------------|---------------------------------------|--|
| 1. Sensor Box | 7. Exhaust Collar (Optional) | 12. Electrical Outlet Retrofit Kit Provision |
| 2. RS232 Port | 8. Electrical Panel | 13. Armrest |
| 3. Power Inlet | 9. Fluorescent Lamp(s) | 14. Exhaust ULPA Filter |
| 4. Sentinel Gold Controller | 10. IV Bar Retrofit Kit Provision | 15. Blower |
| 5. Sash Window | 11. Plugged Service Fixture Provision | 16. Downflow ULPA Filter |
| 6. Single Piece Work Tray | | 17. UV Lamp |

9.2.2 General Specification

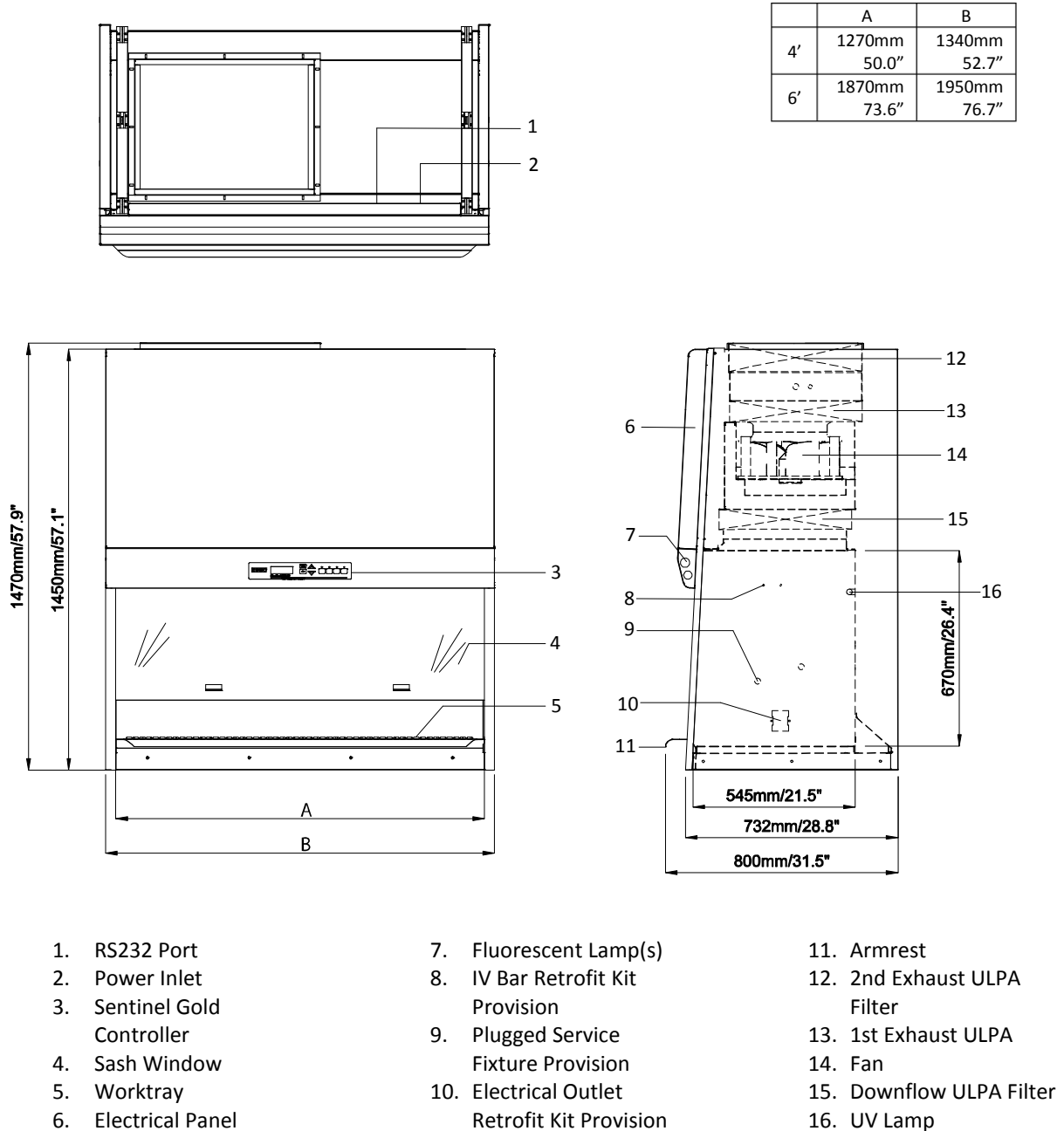
		AC2-3S_	AC2-4S_	AC2-5S_	AC2-6S_
External Dimensions (W x D x H)		1035 x 800 x 1400 mm 40.7" x 31.5" x 55.1"	1340 x 800 x 1400 mm 52.7" x 31.5" x 55.1"	1645 x 800 x 1400 mm 64.7" x 31.5" x 55.1"	1950 x 800 x 1400 mm 76.7" x 31.5" x 55.1"
Gross Internal Dimensions (W x D x H)		970 x 550 x 670 mm 38.2" x 21.7" x 26.4"	1270 x 550 x 670 mm 50.0" x 21.7" x 26.4"	1570 x 550 x 670 mm 61.8" x 21.7" x 26.4"	1870 x 550 x 670 mm 73.6" x 21.7" x 26.4"
Usable Work Area		0.42 m ² (4.6 sq.ft)	0.56 m ² (6.0 sq.ft)	0.71 m ² (7.6 sq.ft)	0.85 m ² (9.1 sq.ft)
Avg. Airflow Velocity	Inflow	0.45 m/s (90 fpm) at initial setpoint			
	Downflow	0.30 m/s (60 fpm) at initial setpoint with uniformity of better than +/- 20%			
Airflow Volume	Inflow	270 m ³ /h (162 cfm)	356 m ³ /h (213 cfm)	440 m ³ /h (263 cfm)	524 m ³ /h (313 cfm)
	Downflow	563 m ³ /h (337 cfm)	741 m ³ /h (443 cfm)	916 m ³ /h (548 cfm)	1091 m ³ /h (652 cfm)
	Exhaust	270 m ³ /h (162 cfm)	356 m ³ /h (213 cfm)	440 m ³ /h (263 cfm)	524 m ³ /h (313 cfm)
	Required Exhaust With Optional Thimble Exhaust Collar	320 m ³ /h (189 cfm)	538 m ³ /h (317 cfm)	615 m ³ /h (362 cfm)	823 m ³ /h (485 cfm)
	Static Pressure For Optional Thimble Exhaust Collar	29 Pa / 0.11 in H ₂ O	31 Pa / 0.12 in H ₂ O	35 Pa / 0.14 in H ₂ O	47 Pa / 0.18 in H ₂ O
ULPA Filter Efficiency	Downflow	>99.999% at 0.1 to 0.3 micron as per IEST-RP-CC001.3 USA			
	Exhaust	>99.999% at MPPS as per EN 1822 (H-14) EU			
Sound Emission *	NSF / ANSI 49	<61 dBA	<62 dBA	<62 dBA	<63 dBA
	EN 12469	<58 dBA	<59 dBA	<59 dBA	<60 dBA
Fluorescent Lamp Intensity		>1040 Lux (>97 foot candles)	>1190 Lux (>111 foot candles)	>920 Lux (>85 foot candles)	>1020 Lux (>95 foot candles)
Cabinet Construction	Main Body	1.2 mm (0.05") 18 gauge electro-galvanized steel with white oven-baked epoxy-polyester Isocide antimicrobial powder coated finish			
	Work Zone	1.5 mm (0.06") 16 gauge stainless steel, type 304, with 4B finish			
	Side Walls	0.9 mm (0.035") 20 gauge stainless steel, type 304			
Electrical	220-240V, AC, 50Hz, 1φ	AC2-3S1	AC2-4S1	AC2-5S1	AC2-6S1
	110-130V, AC, 60Hz, 1φ	AC2-3S2	AC2-4S2	AC2-5S2	AC2-6S2
	220-240V, AC, 60Hz, 1φ	AC2-3S3	AC2-4S3	AC2-5S3	AC2-6S3
Net Weight **		180 kg (397 lbs)	218 kg (481 lbs)	256 kg (563 lbs)	305 kg (672 lbs)

* Sound emission test is conducted in an open field condition/anechoic chamber

** Cabinet only (excluding retrofit kit & support stand)

9.3 AC2- _D_ Series

9.3.1 Engineering Drawing



9.3.2 General Specification

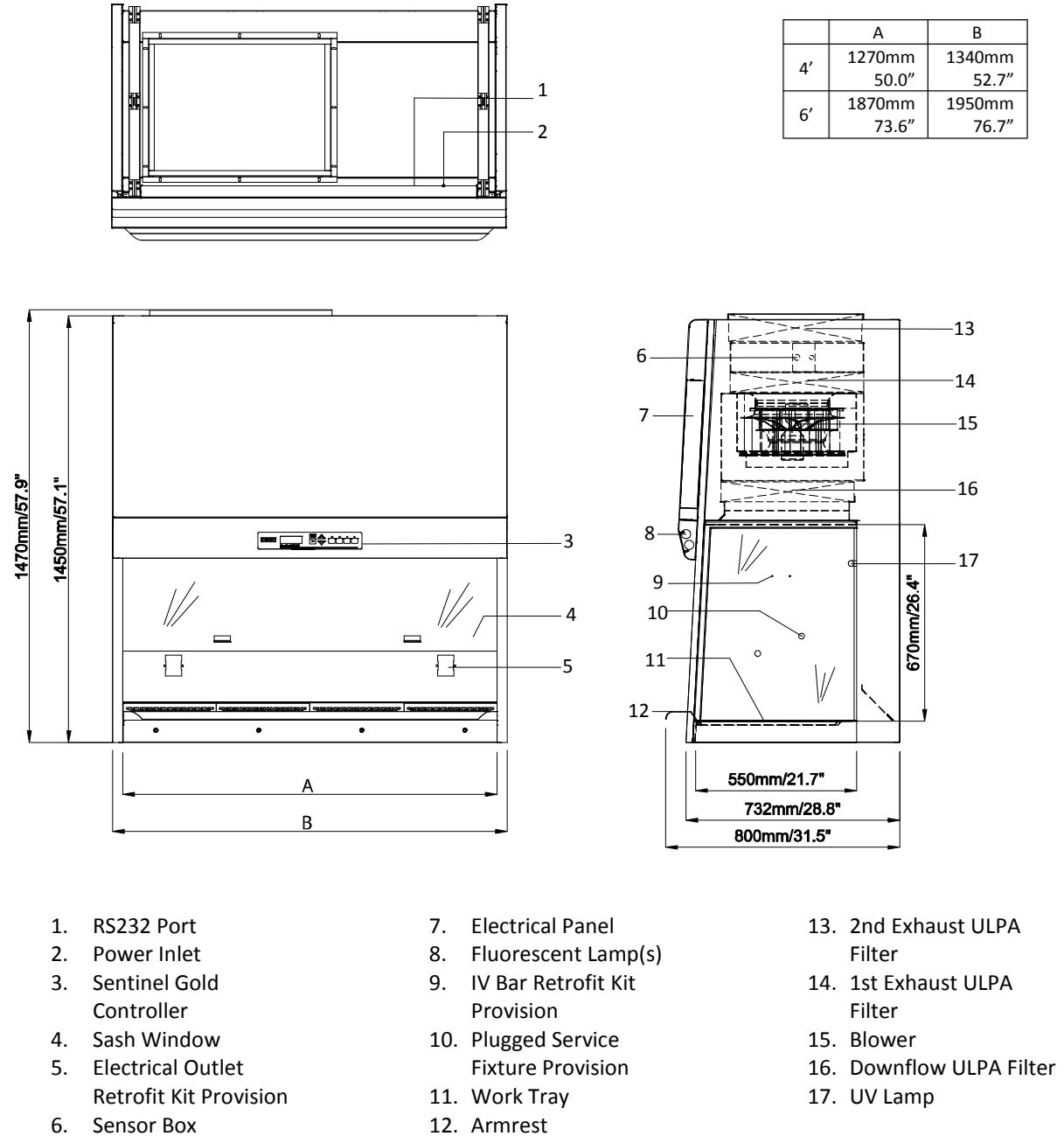
		AC2-4D_	AC2-6D_
External Dimensions (W x D x H)		1340 x 800 x 1470 mm 52.7" x 31.5" x 57.9"	1950 x 800 x 1470 mm 76.7" x 31.5" x 57.9"
Gross Internal Dimensions (W x D x H)		1270 x 545 x 670 mm 50.0" x 21.5" x 26.4"	1870 x 545 x 670 mm 73.6" x 21.5" x 26.4"
Usable Work Area		0.56 m ² (6.0 sq.ft)	0.85 m ² (9.1 sq.ft)
Avg. Airflow Velocity	Inflow	0.45 m/s (90 fpm) at initial setpoint	
	Downflow	0.30 m/s (60 fpm) at initial setpoint with uniformity of better than +/- 20%	
Airflow Volume	Inflow	356 m ³ /h (213 cfm)	524 m ³ /h (313 cfm)
	Downflow	741 m ³ /h (443 cfm)	1091 m ³ /h (652 cfm)
	Exhaust	356 m ³ /h (213 cfm)	524 m ³ /h (313 cfm)
	Required Exhaust With Optional Thimble Exhaust Collar	538 m ³ /h (317 cfm)	823 m ³ /h (485 cfm)
	Static Pressure For Optional Thimble Exhaust Collar	31 Pa / 0.12 in H ₂ O	47 Pa / 0.18 in H ₂ O
ULPA Filter Efficiency	Downflow	>99.999% at 0.1 to 0.3 micron as per IEST-RP-CC001.3 USA	
	Exhaust	>99.999% at MPPS as per EN 1822 (H-14) EU	
Sound Emission *	NSF / ANSI 49	<62.5 dBA	<63 dBA
	EN 12469	<59.5 dBA	<60 dBA
Fluorescent Lamp Intensity		>1200 Lux (>111.5 foot candles)	>1020 Lux (>95 foot candles)
Cabinet Construction	Main Body	1.2 mm (0.05") 18 gauge electro-galvanized steel with white oven-baked epoxy-polyester Isocide antimicrobial powder coated finish	
	Work Zone	1.5 mm (0.06") 16 gauge stainless steel, type 304, with 4B finish	
	Side Walls	0.9 mm (0.035") 20 gauge stainless steel, type 304	
Electrical	220-240V, AC, 50Hz, 1φ	AC2-4D1	AC2-6D1
	220-240V, AC, 60Hz, 1φ	AC2-4D3	AC2-6D3
Net Weight **		223.5 kg (492.7 lbs)	315 kg (694 lbs)

* Sound emission test is conducted in an open field condition/anechoic chamber

** Cabinet only (excluding retrofit kit & support stand)

9.4 AC2-_G_Series

9.4.1 Engineering Drawing



9.4.2 General Specification

		AC2-4G_	AC2-6G_
External Dimensions (W x D x H)		1340 x 800 x 1470 mm 52.7" x 31.5" x 57.9"	1950 x 800 x 1470 mm 76.7" x 31.5" x 57.9"
Gross Internal Dimensions (W x D x H)		1270 x 545 x 670 mm 50.0" x 21.5" x 26.4"	1870 x 545 x 670 mm 73.6" x 21.5" x 26.4"
Usable Work Area		0.56 m ² (6.0 sq.ft)	0.85 m ² (9.1 sq.ft)
Avg. Airflow Velocity	Inflow	0.45 m/s (90 fpm) at initial setpoint	
	Downflow	0.30 m/s (60 fpm) at initial setpoint with uniformity of better than +/- 20%	
Airflow Volume	Inflow	356 m ³ /h (213 cfm)	524 m ³ /h (313 cfm)
	Downflow	741 m ³ /h (443 cfm)	1091 m ³ /h (652 cfm)
	Exhaust	356 m ³ /h (213 cfm)	524 m ³ /h (313 cfm)
	Required Exhaust With Optional Thimble Exhaust Collar	538 m ³ /h (317 cfm)	823 m ³ /h (485 cfm)
	Static Pressure For Optional Thimble Exhaust Collar	31 Pa / 0.12 in H ₂ O	47 Pa / 0.18 in H ₂ O
ULPA Filter Efficiency	Downflow	>99.999% at 0.1 to 0.3 micron as per IEST-RP-CC001.3 USA	
	Exhaust	>99.999% at MPPS as per EN 1822 (H-14) EU	
Sound Emission *	NSF / ANSI 49	<62 dBA	<63 dBA
	EN 12469	<59 dBA	<60 dBA
Fluorescent Lamp Intensity		>1280 Lux (>119 foot candles)	>1220 Lux (>113 foot candles)
Cabinet Construction	Main Body	1.2 mm (0.05") 18 gauge electro-galvanized steel with white oven-baked epoxy-polyester Isocide antimicrobial powder coated finish	
	Work Zone	1.5 mm (0.06") 16 gauge stainless steel, type 304, with 4B finish	
	Side Walls	UV absorbing tempered glass, 5 mm (0.2"), colorless and transparent	
Electrical	220-240V, AC, 50Hz, 1φ	AC2-4G1	AC2-6G1
	220-240V, AC, 60Hz, 1φ	AC2-4G3	AC2-6G3
Net Weight **		213 kg (470 lbs)	310 kg (683 lbs)

* Sound emission test is conducted in an open field condition/anechoic chamber

** Cabinet only (excluding retrofit kit & support stand)

APPENDIX

NO	COLOR	AWG
1	Black	14
2	White	14
3	Green	14
4	Red	14
5	Blue	14
6	G/Y	14
7	Red	14
8	Red	14
9	Red	14
10	Red	14
11	Red	14
12	Red	14
13	Blue	14
14	Blue	14
15	Blue	14
16	Blue	14
17	Blue	14
18	Red	14
19	Red	16
20	Red	16
21	Red	16
22	Red	16
23	Blue	16
24	Red	16
25	Blue	16
26	Red	16
27	G/Y	16
28	Red	16
29	Blue	16
30	G/Y	16
31	Red	16
32	Red	18
33	Blue	18
34	Red	18
35	Blue	18
36	Red	18
37	Black	18
38	Black	18
39	Red	18
40	Red	18
41	Brown	18
42	Brown	18
43	Yellow	18
44	Yellow	18
45	Blue	18
46	Red	18
47	Red	18
48	Black	18
49	Yellow	18
50	Red	14
51	Black	18
52	Blue	18
53	Brown	16
54	Red	14
55	Blue	16
56	Blue	14
57	Black	14
58	Red	14
59*	G/Y	14
60*	G/Y	14
61*	G/Y	14
62*	G/Y	14
63*	G/Y	16
64	Black	16
65	Blue	16
66	Brown	16

SMPS

NO	COLOR	AWG
101	Black	18
102	White	18
103	Green	18

Fluorescent Ballast

NO	COLOR	AWG
107	Black	18
108	White	18
109	Red	18
110	Red	18
111	Blue	18
112	Blue	18
113	Yellow	18
114	Yellow	18
115	Yellow	18
116	Yellow	18
117	Red	18
118	Red	18
119	Blue	18
120	Blue	18
121	Yellow	18
122	Yellow	18
123	Yellow	18
124	Yellow	18

UV Ballast

NO	COLOR	AWG
161	Black	18
162	White	18
164	Red	18
165	Red	18
166	Yellow	18
167	Yellow	18
173	Red	18
174	Red	18
175	Blue	18
176	Blue	18

Socket Outlet

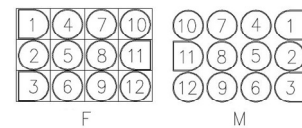
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191	Black	16
192	White	16
193	Green	16
194	Black	16
195	White	16
196	Green	16
215	Black	16
216	White	16
217	Green	16
218	Black	16
219	White	16
220	Green	16

Blower

NO	COLOR	AWG
239	Black	16
240	Blue	16
241	Brown	16
242	G/Y	16
243	Black	16
244	Blue	16
245	Brown	16
246	G/Y	16

* Ground Wires

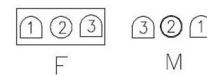
Connector A, B, C, D



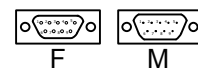
Connector X9, X10



Connector X11, X12, X13, X15



RS 232



ESCO

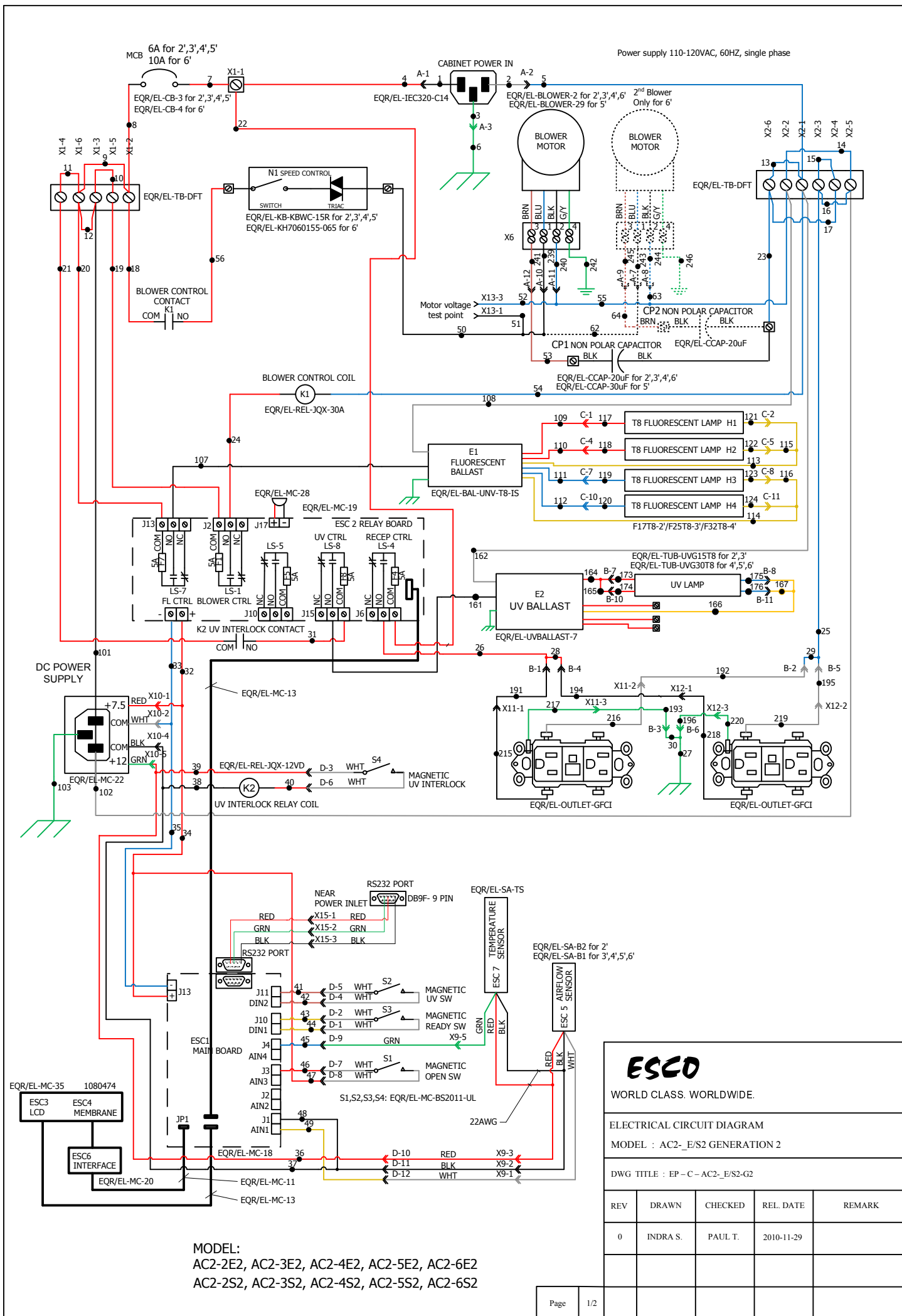
WORLD CLASS. WORLDWIDE.

ELECTRICAL CIRCUIT DIAGRAM

MODEL : AC2_E/S1/3 G2

DWG TITLE : EP - A - AC2_E/S1/3-G2

REV	DRAWN	CHECKED	REL. DATE	REMARK
0	INDRA W	INDRA S	2010-10-28	



MODEL:
AC2-2E2, AC2-3E2, AC2-4E2, AC2-5E2, AC2-6E2
AC2-2S2, AC2-3S2, AC2-4S2, AC2-5S2, AC2-6S2

ESCO

WORLD CLASS. WORLDWIDE.

ELECTRICAL CIRCUIT DIAGRAM

MODEL : AC2_E/S2 GENERATION 2

DWG TITLE : EP - C - AC2_E/S2-G2

REV	DRAWN	CHECKED	REL. DATE	REMARK
0	INDRA S.	PAUL T.	2010-11-29	

NO	COLOR	AWG
1	Black	14
2	White	14
3	Green	14
4	Red	14
5	Blue	14
6	G/Y	14
7	Red	14
8	Red	14
9	Red	14
10	Red	14
11	Red	14
12	Red	14
13	Blue	14
14	Blue	14
15	Blue	14
16	Blue	14
17	Blue	14
18	Red	14
19	Red	16
20	Red	16
21	Red	16
22	Red	16
23	Blue	16
24	Red	16
25	Blue	16
26	Red	16
27	G/Y	16
28	Red	16
29	Blue	16
30	G/Y	16
31	Red	16
32	Red	18
33	Blue	18
34	Red	18
35	Blue	18
36	Red	18
37	Black	18
38	Black	18
39	Red	18
40	Red	18
41	Brown	18
42	Brown	18
43	Yellow	18
44	Yellow	18
45	Blue	18
46	Red	18
47	Red	18
48	Black	18
49	Yellow	18
50	Black	14
51	Black	18
52	Blue	18
53	Brown	16
54	Blue	16
55	Blue	14
56	Red	14
57*	G/Y	14
58*	G/Y	14
59*	G/Y	14
60*	G/Y	14
61*	G/Y	16
62	Red	16
63	Blue	16
64	Brown	16

SMPS

NO	COLOR	AWG
101	Black	18
102	White	18
103	Green	18

Fluorescent Ballast

NO	COLOR	AWG
107	Black	18
108	White	18
109	Red	18
110	Red	18
111	Blue	18
112	Blue	18
113	Yellow	18
114	Yellow	18
115	Yellow	18
116	Yellow	18
117	Red	18
118	Red	18
119	Blue	18
120	Blue	18
121	Yellow	18
122	Yellow	18
123	Yellow	18
124	Yellow	18

UV Ballast

NO	COLOR	AWG
161	Black	18
162	White	18
164	Red	18
165	Red	18
166	Yellow	18
167	Yellow	18
173	Red	18
174	Red	18
175	Blue	18
176	Blue	18

Socket Outlet

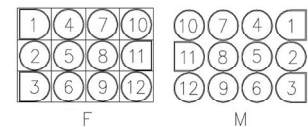
NO	COLOR	AWG
191	Black	16
192	White	16
193	Green	16
194	Black	16
195	White	16
196	Green	16
215	Black	16
216	White	16
217	Green	16
218	Black	16
219	White	16
220	Green	16

Blower

NO	COLOR	AWG
239	Black	16
240	Blue	16
241	Brown	16
242	G/Y	16
243	Black	16
244	Blue	16
245	Brown	16
246	G/Y	16

* Ground Wires

Connector A, B, C, D



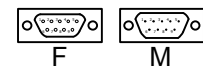
Connector X9, X10



Connector X11, X12, X13, X15



RS 232



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WORLD CLASS. WORLDWIDE.

ELECTRICAL CIRCUIT DIAGRAM

MODEL : AC2- E/S2 GENERATION 2

DWG TITLE : EP - C - AC2- E/S2-G2

REV	DRAWN	CHECKED	REL. DATE	REMARK
0	INDRA S.	PAUL T.	2010-11-29	

LOG RECORD

Cabinet : _____
Serial Number : _____
Person in Charge : _____

1. This log record should be used by the operator to record any new agent/virus/bacteria/germs that has been introduced to the cabinet during its operation, problems encountered, etc.
2. Any decontamination procedure performed by either the user or the technician should be recorded down as well.
3. Please also record any major maintenance procedure performed by the service technician, for example: parts replacement, recertification, etc.

[illegible]

In case of emergencies, please call:

Name : _____

Cell Phone Number : _____

E-mail : _____

